the OIL AND GAS JOURNAL

PUBLISHED WEEKLY APRIL 24, 1961

NATURAL GAS...

No. 1 target for explorationists?

p. 90

Annual EXPLORATION Number

KENNEDY'S GAS PROPOSAL

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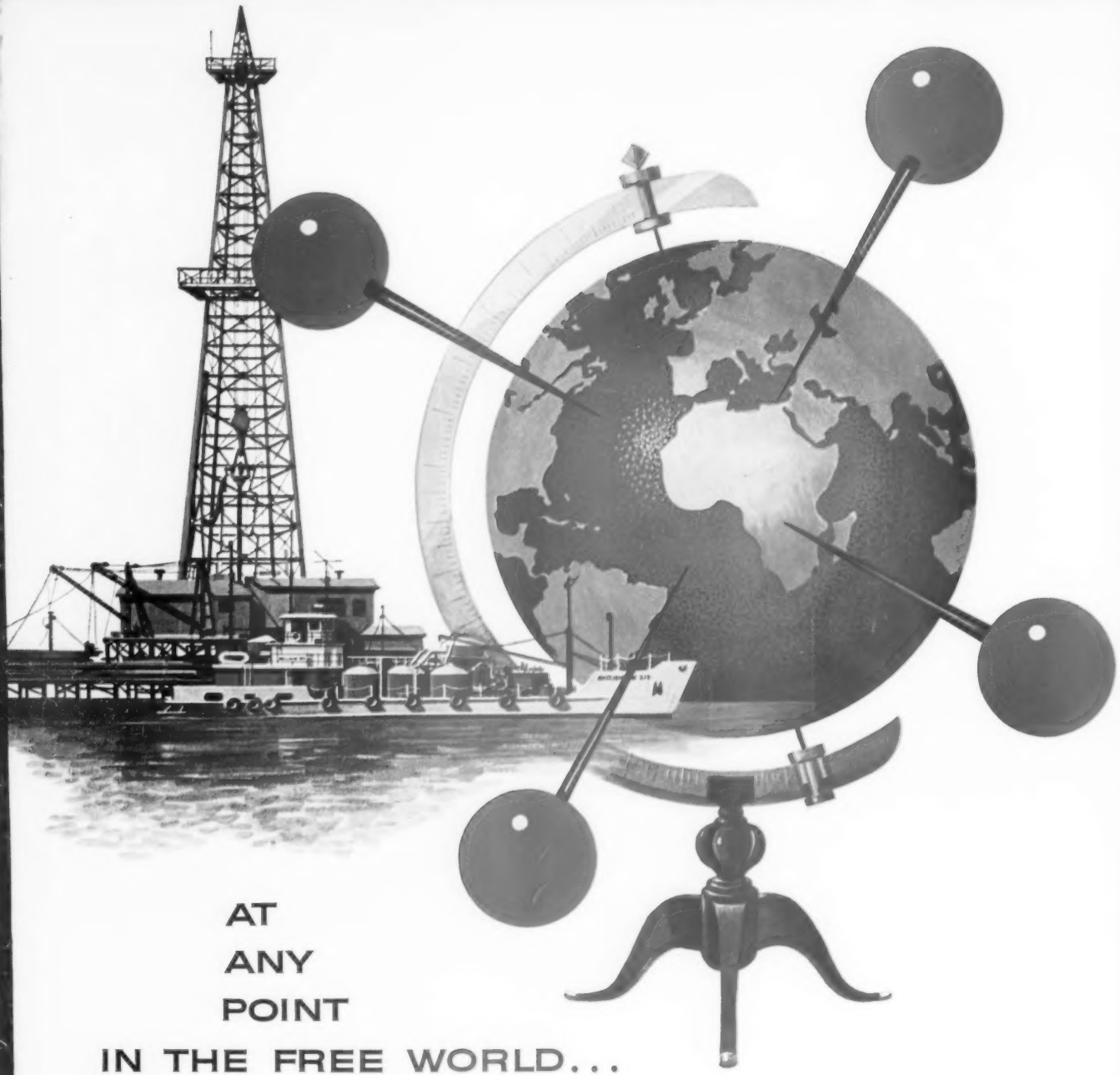

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OIL AND GAS JOURNAL
Vol. 59, No. 17

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the OIL AND GAS JOURNAL Newsletter

Tulsa, Okla.
April 24, 1961

Gas may become a hot issue before Congress:

President Kennedy has succeeded in reviving the question which had appeared dead this session with a proposal that small producers be exempt from direct control.

Way is open now for public hearings and considering a wide range of suggestions. And the odds are heavy against adoption of the President's exemption plan (p. 63)*.

Pre-hearing conference on area-pricing approach to gas regulation appears bogged down. It's a good bet FPC will abandon this idea and order its staff to proceed with a formal area-price hearing—probably this fall.

▼ ▼ ▼

Foreign drilling is trailing last year.

Latest Journal survey shows 806 rigs on new hole this month compared with 867 last year and 842 in October (p. 88).

A pickup, however, is noted in some areas with 20 additional rigs being put to work in recent weeks, notably in French areas.

Domestic drilling picked up slightly this week to 1,638 active rotary rigs compared with 1,617 the week before.

Active rotaries last year at this time totaled 1,829 or 191 more than this year.

Wildcatting success ratio of the industry is in dispute again.

For 11 years, 1 out of 9 wildcats has been a successful producer of some oil or gas in the year in which discovered.

But measured by profitability over a 6-year production period, the 11-year average is 1 in 45, and in 1960 success hit an all-time low of 1 in 60 (p. 205).

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Bottom section of deep wildcat in Alaska has been abandoned.

The 1 Falls Creek on Cook Inlet of Kenai Peninsula has been plugged by California Standard at 8,600 ft. after going to 13,795

*Refers to article in this issue giving more details. When no page is given, the item is a Newsletter exclusive.

ft. Operator now is testing the Kenai formation. Well is being whipstocked under the inlet from an onshore location.

World's first sextuple oil completion is planned by Humble in Borregos field on the King Ranch. Five zones already have been put on production from a single well bore. Sixth will be added soon.

Two other sextuple completions are in existence—both by Sunray Mid-Continent. One produces six gas zones and the other five gas zones and one oil.

▼ ▼ ▼

Decision on Transcontinental's proposed LPG line can wait until mid-June, says President E. Clyde McGraw, who adds, "We have not abandoned the idea."

Mid-June is deadline to get line ready for 1961-62 winter season. Pipe and contractors both are available. Big obstacle: plans of Dixie LPG Pipeline Co. to build competing line that would parallel Transco line and preempt part of product shipments.

Move to tap British Columbia's huge gas reserves in the Fort Nelson area will be delayed until 1963 or 1964.

The 30-in. northern extension of Westcoast Transmission's Vancouver-Fort St. John line originally was programmed for 1961 but is being held up until the California markets justify spending $200 million-plus for the line.

Most of Fort Nelson gas would move eventually into California lines of El Paso Natural Gas.

▼ ▼ ▼

Pilot plants for testing on-stream analyzers before they are put on process units are spreading. Advantages: Instruments can be debugged more easily to cut installation and maintenance costs and new instruments can be more quickly developed.

On-stream wet-chemical analyzers fill a gap where other analytical instruments don't apply. They permit unit operation at low loss, thus cutting raw material costs and helping avoid upsets.

In the future they will become more complex and analyze for more than one component. Nuclear techniques are promising in this respect. Two promising methods: Carbon, hydrogen, and oxygen analysis by x-rays from small, inexpensive, and safe sources; and on-stream monitoring of oxygen in hydrocarbon streams with neutron sources.

Petrochem notes: Low cost C_6 olefins of high purity now can be made by a new Houdry process. One suggested use of the materials is as monomers for stereospecific polymerization...Synthetic rubber production in U. S. last year totaled 2,952 million pounds compared with output of 2,825 million pounds in 1959.

▼ ▼ ▼

Lack of interest in bidding on work in the space geophysical

program by qualified contracting firms in the oil industry has government officials puzzled.

Contracts open include both manufacturing and operating. The pie is big too—$60 million this year and an expected $100 million in 1962.

Aircraft firms generally have shown keen interest but oil-oriented geophysical contractors shunned the government jobs. It's hard to know why because 1960 reports show contractors who diversify are doing well. Many others are struggling to stay in business.

Sale of Honolulu Oil to Pan American and Tidewater should be completed early in May, Honolulu officials report, scotching rumors that negotiations may have run into trouble.

Price is expected to be about $90 a share or a total of $337,587,480 in initial liquidation payments with a smaller second payment to stockholders likely.

▼ ▼ ▼

The Washington beat:

New England Council is stepping up its campaign to get a new residual fuel oil study by Office of Civil and Defense Mobilization.

Council wrote OCDM last week that recent OCDM report showing price increases was one more reason why control program should be reviewed to determine whether it serves the national security.

The council also is enlisting the support of U. S. senators from New England and outlook is good that the study will be made.

Hearing on appointment of Joseph C. Swidler to FPC will be resumed by a Senate Committee May 2. Meanwhile, committee has delayed action on another appointee, Howard Morgan, even though hearing for him has been completed.

U. S. has wasted no time implementing new policy of helping finance sales of domestic oil equipment abroad.

One credit application has been approved—8 or 10 others are in the works.

First deal involved sale of $1.5 million of gas and water separation equipment and crude-oil metering equipment to Argentina's oil company by National Supply Division of Armco Steel Corp. YPF paid 20% down. Export-Import Bank and Chase Manhattan Bank supplied the rest, about $610,000 each.

Newcomers to helium program may face delay.

Interior originally asked $60 million to buy helium but House trimmed the appropriation to $35 million. This amount is expected to cover contracts now being negotiated with four companies. Other contracts may be delayed until Congress adds more funds later.

Market Memo

April 24, 1961

Texas crude market is uneasy.

Tidewater's 15-cent per barrel cut in its postings for East Texas is further evidence. Company's new price is $3.10 a barrel instead of $3.25 for 8,000 bbl. daily it takes.

Tidewater's explanation: New price will place East Texas crude in a better competitive position in relation to other domestic oil.

Many Texas buyers have felt for months that East Texas crude is overpriced while sour crude in West Texas is underpriced. Both compete in the Gulf Coast refining market.

Gulf Oil and Texas Standard last month attempted to effect a balance by raising West Texas sour crude by 6 cents. Move hasn't picked up any support, however. Now Tidewater's move could be the ultimate approach to a balance.

East Texas is a touchy crude since it's used as an index for foreign pricing, especially in Venezuela.

But for more than a year it has been priced at three levels below the $3.25 top and now about 45,000 bbl. daily is selling at the reduced prices. Atlantic Refining posts at $3.05, Sinclair at $3.10, same as Tidewater, and Premier at $3.15.

The Tidewater action has Texas crude buyers closely studying the economics of their postings which could mean more adjustments.

Other pricing moves: California Standard has hiked posting for Swanson River crude in Alaska by 20 cents a barrel. Kenai Pipe Line cut its tariff from 40 to 20 cents. Chief gainer is Alaska's state government which gets a royalty income from production.

Product markets: Refining cutbacks are giving a stronger tone to the outlook. Runs dropped 110,000 bbl. daily in week to 7,789,-000 and product stocks fell 4.6 million barrels. Gasoline stocks fell 2,483,000 bbl. and distillates 1,873,000. More of this kind of action should ease the pressure on prices.

Gasoline postings generally are holding in the Mid-Continent and Gulf despite weak spots. Esso and Mobil cut dealer tankwagon prices in some New England points.

Distillate demand remains surprisingly good for the season and is moving well at some discounting. Esso cut postings in Southeast.

Marketing notes: Gasoline-blending pumps are legal in Colorado. Denver judge rules they do not violate law prohibiting mixing of fuel by retailers...Tinplate makers soon will have a lighter and thinner product that will compete with aluminum in packaging of motor oil. It should mean real savings to lube manufacturers... Hess is invading New York with stations at Greenwich, Syracuse, Albany, and Utica—prices will be 2 cents below majors.

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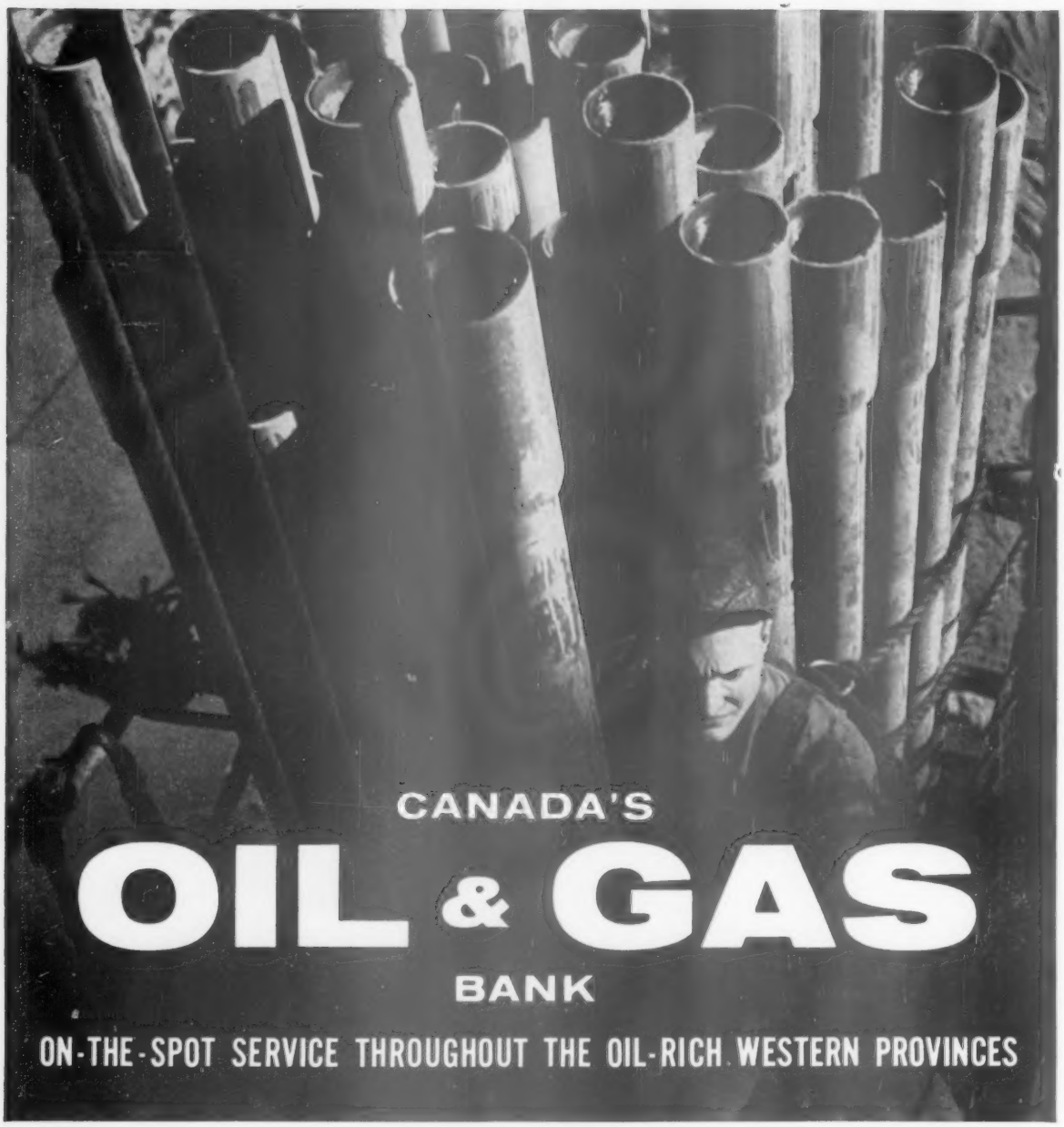
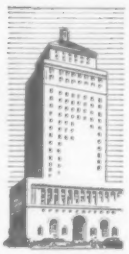


Canada's largest bank—the Royal—is in an exceptionally favorable position to provide complete banking services to oil and gas men.

Over 300 branches are strategically placed throughout the oil and gas rich areas of Western Canada, each offering on-the-spot facilities. In addition, an Oil and Gas Department in Calgary extends many valuable special services required by oil and gas men. Small wonder that the Royal is known as Canada's "Oil and Gas Bank."



A list of current Oil and Gas bulletins covering regulations, tariffs, financing, statistics and kindred subjects pertaining to the Canadian industry is available on request. Write to Mr. H. E. McClenaghan, Room 1523, 300 North Ervay St., Dallas 1, Texas; or to The Royal Bank of Canada, Oil and Gas Dept., 409 Eighth Avenue West, Calgary, Alberta.

We do not provide information on oil securities.

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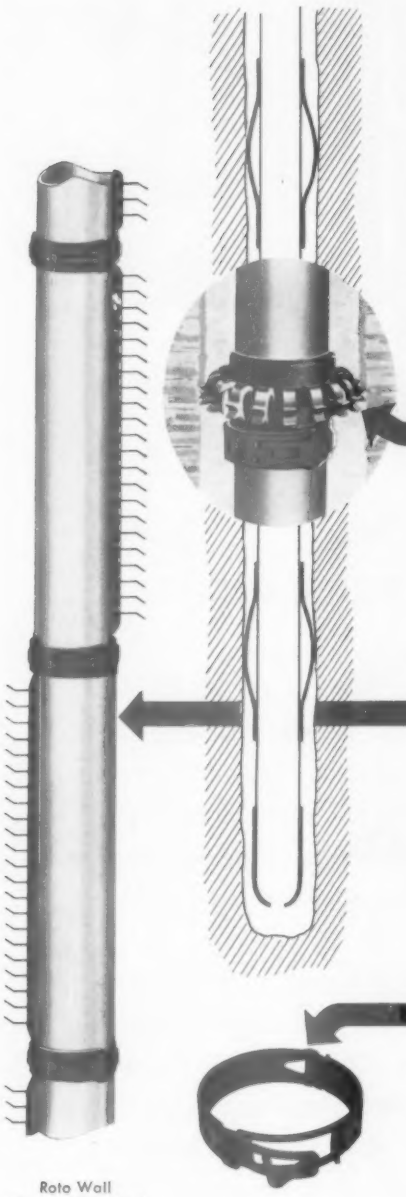

Roto Wall Cleaners Installed with EZ Lok Limit Clamp

IMPROVE CEMENT BONDING AND REDUCE CHANNELING

The secret of a stronger, more durable primary cementing job often depends on the effective action of wall cleaners in preparing the surface of the well bore for the best bond of cement to formation and casing possible. A good job done here can minimize the chances for remedial and squeeze cementing jobs later.

RECIPO WALL CLEANERS ... *operate as casing is reciprocated.*

These wall cleaners are designed to remove the toughest filter cake as the casing is pulled up, but not damage the upper surfaces of the well bore as the casing is lowered. Flexible rubber cleaning fingers are extra wide to cover more bore hole surface and clean more thoroughly. As the casing is reciprocated during cement placement, the Recipo Wall Cleaners also tend to make the cement flow in the annulus with more turbulence, lessening the chance of channeling. Each tool is hinged for fast and easy installation.

ROTO WALL CLEANERS ... *operate as casing is rotated.*

This type wall cleaner is equipped with stout, claw-type spring steel cleaning spikes designed to minimize mud cake damage during run-in for protection against lost circulation and reduce the hazard of sticking casing off casing point. Later, when the casing is rotated, the fingers help remove undesirable filter and mud cake which might prevent a good cement bond in the annulus around the casing. In addition to the standard size cleaner which fits all casing O.D. sizes, Slim Hole models are available to fit the reduced annular clearance in these applications. Roto Wall Cleaners are designed for installation with EZ Lok Limit Clamps or tack welding.

EZ LOK LIMIT CLAMPS ... *efficient, inexpensive, easy to install on casing.*

These unique "latch-on" limit clamps are designed to hold loads up to 20,000 pounds and prevent movement of downhole equipment such as the two types of Halliburton wall cleaners described above, casing centralizers, cement baskets, and other auxiliary outside casing equipment. Holding power equal to tack welding is provided by these clamps – and equipment can be installed on the casing at any selected point on the string.

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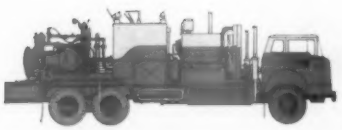

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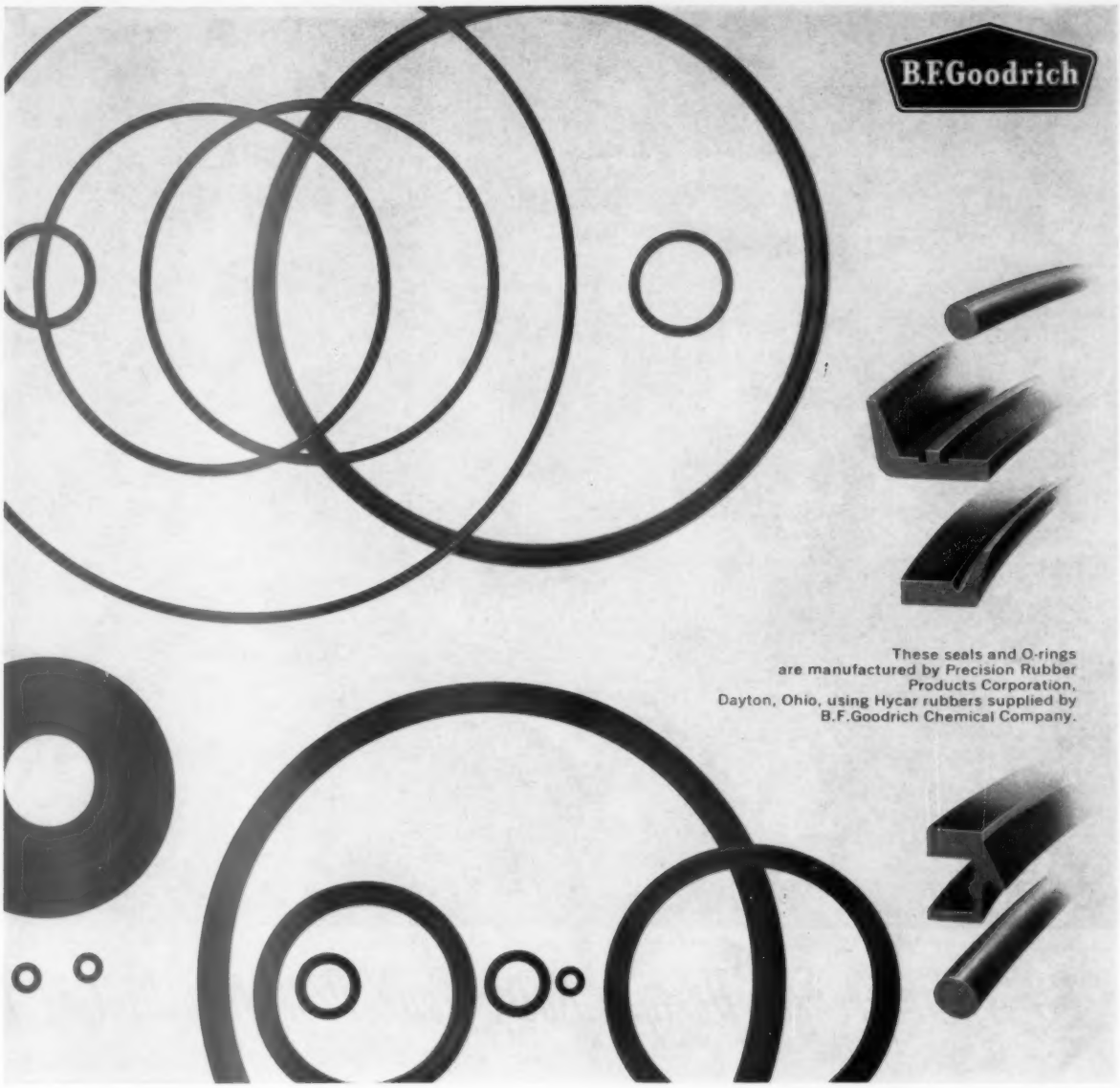

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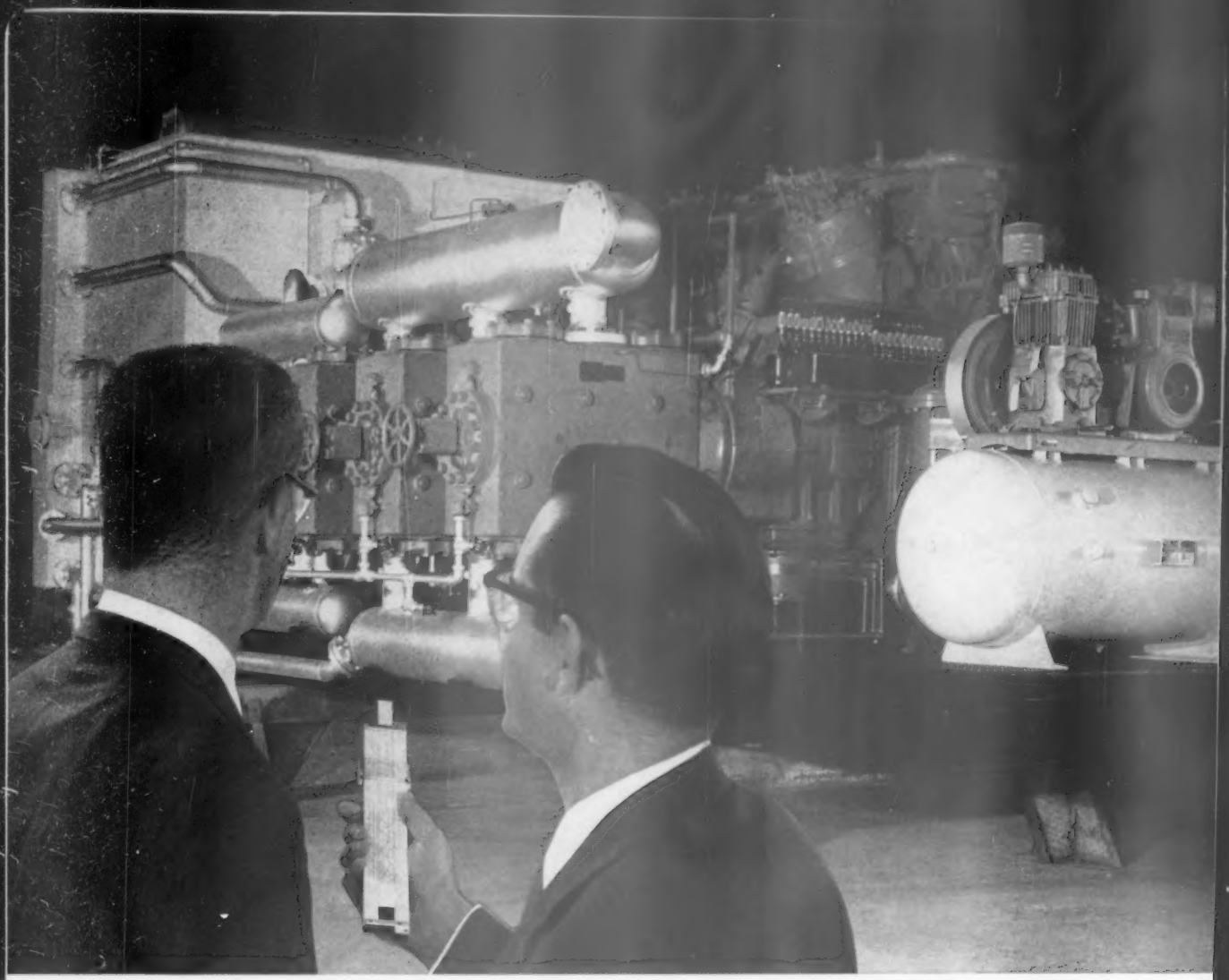

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to waterflood operators who do not fracture wells

A few operators are still afraid to fracture waterflood injection and producing wells in spite of the fact that fracturing programs for waterflood projects are widely accepted. Here are some questions frequently brought up by these operators. The answers are based on records of thousands of treatments performed by Dowell.

QUESTION:

Will fracturing hasten breakthrough between injection and producing wells?

ANSWER:

Generally speaking, *no!* A poorly-designed fracture treatment of a producing well — performed too early in the life of a flood — can hasten breakthrough. In practice, however, this seldom happens.

Normally, breakthrough has been either unaffected or actually retarded by Dowell-engineered fracture treatments that were performed at the correct time.

QUESTION:

Will a premature breakthrough reduce ultimate economic recovery?

ANSWER:

If breakthrough does occur between an injection and a producing well, loss can usually be avoided by an appropriate change in the well pattern.

Dowell-engineered fracturing, however, has generally reduced, rather than increased, premature breakthrough.

QUESTION:

Will breakthrough to formation water reduce economic recovery?

ANSWER:

Loss can usually be avoided by changing the pattern of producing wells and injection wells. If formation water is likely to be a problem, however, Dowell engineers often design treatments to avoid breakthrough.

QUESTION:

Will fracturing affect water/oil ratios?

ANSWER:

Not in a consistent manner. Water/oil ratios may be increased, unchanged or reduced by fracturing. This is usually unimportant, however, since a waterflood that has been fractured should accommodate a higher water cut economically than one that is operated without fracturing. Dowell engineers design treatments on waterflood wells to avoid excessive water production.

QUESTION:

Will fracturing increase water handling costs?

ANSWER:

Fracturing programs have generally *reduced* water handling costs per barrel of oil produced. The daily costs of water handling may be increased, since so much more water is being handled, but oil production is usually increased so much that cost per barrel of oil is reduced.

Dowell engineers regularly design fracture treatments to minimize water pumping costs.

QUESTION:

Will fracturing costs reduce net profits?

ANSWER:

Fracturing costs have been negligible when compared with the savings realized. When successful fracturing programs are employed, fewer wells are required and well spacing can be wider. Since frac jobs are considerably less expensive than the drilling of new wells, the investment required for a given flood is decreased rather than increased by a successful, well-planned fracturing program.

When a successful fracturing program is initiated, daily production is increased while operating costs are affected little if at all; the result is lower operating costs per barrel of oil.

Dowell-engineered fracturing programs have been outstanding in helping waterflood operators increase net profits.

To summarize, waterflood operators have everything to gain by checking on the advantages of fracturing wells in a flood. For full information, call your nearest Dowell representative. Dowell services and products are offered from more than 150 offices and stations in the United States, Canada, Venezuela, Argentina, Germany, France and the Sahara area. Dowell, Tulsa 1, Oklahoma.

SERVICES FOR THE OIL INDUSTRY

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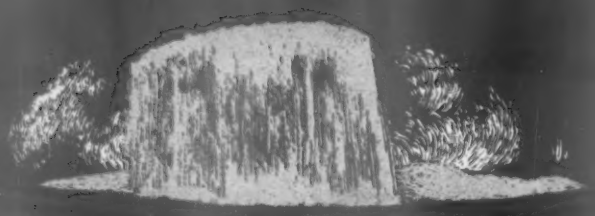
VISQUEEZ slurry shuts off water where all other methods fail!



BJ Service

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For complete details, call your local BJ Service field station today.

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Visqueez Increases Oil Production 30%—Decreases Water Production 27%

PROBLEM: To lower the water/oil ratio of the producing wells in a water-flood system in Wyoming. SOLUTION: Visqueez was used to treat 16 producing wells with an aggregate production of 10,883 BWPD and 897 BOPD. Following Visqueez treatments, water production has decreased to 7,983 BPD and oil production has increased to 1,169 BPD. Over-all results: water production down 27%—net oil production *up* 30%.

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RCA "LD" 2-way radio has the guts to stand up to the toughest jobs!

There are rugged places where men, trucks and 2-way radios have to go, and each has to be a proven, reliable performer. In 2-way radio, this means quality must be built-in to take the gaff—quality such as only the leader in radio and electronics can offer—in the new RCA "LD" (Low battery Drain). Quality and price are combined in this dependable RCA equipment to give you the very best performance at the lowest cost. Use it on the roughest roads—Security Sealed Circuits are your assurance it can take it. Leave the radio on when your vehicle engine is turned off—battery drain is negligible—transistors are used in circuits where they have been proven to be most dependable.

It took experience and daring to bring you today's RCA 2-Way Radios. It meant discarding preconceived notions about circuits and redesigning with transistors in key places for reliability with economy. And it involved engineering a host of other advanced features to assure fine message intelligibility, and long component life at moderate cost.

Your RCA Communications Specialist will be glad to show you why the "LD", dollar for dollar, feature for feature, is today's greatest 2-way radio value. Or send coupon for further facts.

RCA

The Most Trusted Name in Radio

RADIO CORPORATION OF AMERICA

RADIO CORPORATION OF AMERICA
Telecommunication Center, Dept. TD-89
Meadow Lands, Pa.

☐ Please send me FREE literature on the new RCA Transistorized Mobile Radio.

☐ Have RCA Communications Specialist contact me and explain why this is today's best value in 2-way radio.

NAME _____ TITLE _____

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CHANGE CAPACITY
CHANGE LOCATION

It's easy with
JOY GAS BOOSTERS

Joy packaged gas boosters are completely flexible. The complete unit on the skid is well within the allowable size limits for over-the-road hauling to permit easy change of location. Flexibility to match varying conditions in the well is provided by Joy's replaceable cylinder liners, which can be changed to vary compressor capacity. For wide fluctuations in well conditions, the entire cylinder assembly can be changed—any Joy cylinder fits every Joy compressor.

For gas boosting units rugged enough to stand up under the severe service conditions, and flexible enough to meet any operating requirements in the field, consult your Joy fabricator. He has a complete range of sizes from 50 to 400 hp—up to 7400 cfm.

Denver, Colorado: Emrick & Hill Engine & Equipt. Co. • 4841 E. 38 St.
Houston 2, Texas: Oil & Gas Supply Company • 2525 San Jacinto St.
Long View, Texas: Cherco Equipment, Incorporated • P. O. Box 2229
Pittsburgh 34, Penna.: P. C. McKenzie Company • 3829 Willow Avenue
Tulsa, Oklahoma: Cherokee Steel, Incorporated • 160 N. Rockford

RUST-OLEUM®

STOPS RUST!®

and matches ORIGINAL EQUIPMENT

COLORS

Distinctive as your own fingerprint. Accept no substitute.

How much does rusty equipment cost *you?* With Rust-Oleum, you STOP RUST—and you match original equipment colors, too, for long-lasting protection!

We want you to see for yourself how *easy* it is to use Rust-Oleum . . . actually take the brush and see how smoothly it works, how it dries to an *attractive, high-gloss finish* that resists sun, fumes, rain, heat, snow, salt air and salt spray, and blowing dust and sand. And the same formula can be applied by brush or spray. Just check the coupon for the color you want . . . and attach it to your business letterhead for a FREE TEST SAMPLE. No cost or obligation.

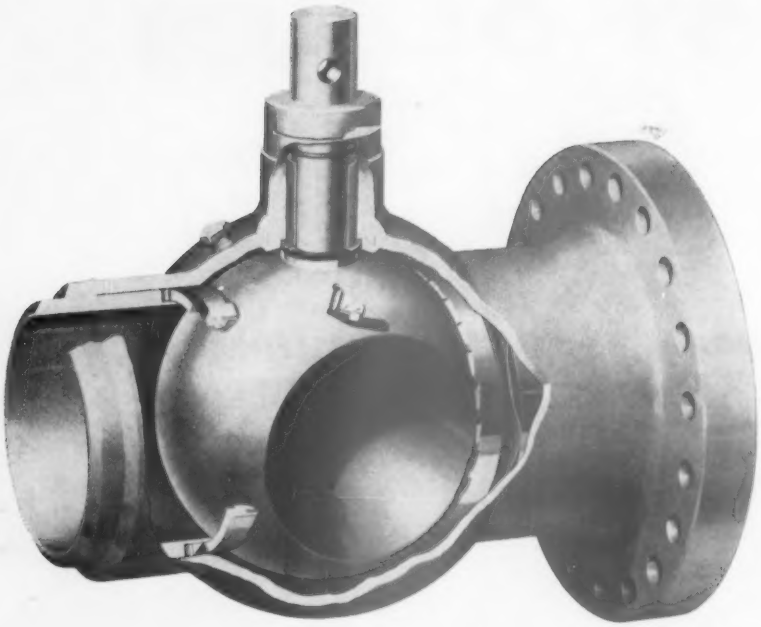
Your Rust-Oleum Distributor maintains complete stocks for immediate delivery.

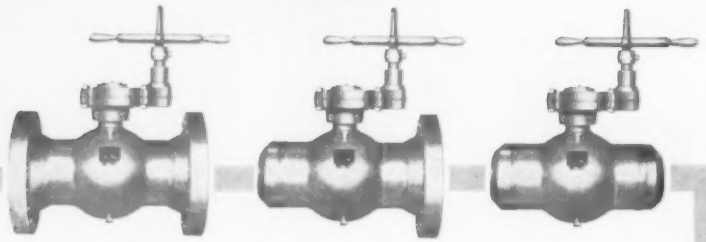
ATTACH COUPON TO YOUR BUSINESS LETTERHEAD FOR FREE TEST SAMPLE

CHECK COLOR TO MATCH YOUR EQUIPMENT

RUST-OLEUM CORPORATION, 2577 Oakton St., Evanston, Ill.
Please send me a FREE TEST SAMPLE in the color checked:

- ☐ 769 Damp-Proof Red Primer
- ☐ 634 Quick Drying Black
- ☐ 2766 High Gloss White
- ☐ 470 Ready Mixed Aluminum
- ☐ H-4 Caterpillar Yellow
- ☐ 722 Bethlehem Yellow
- ☐ 726 New Emsco Green
- ☐ 727 New Unit Rig Gray
- ☐ 724 Waukesha Gray
- ☐ 721 National Blue
- ☐ 723 Oil Well Orange





NEW—FOR GENERAL USE

For Pipe Lines — Chemical, Refining and Gas Processing Plants — Oil Well Drilling and Producing

Cameron

BALL VALVE

with the Exclusive Rotating Seats

These valves handle the most abrasive and corrosive fluids—cannot freeze—cannot develop excessive body pressure; provide up-stream seating, double block and bleed, all with unbelievably easy operation.

Cameron Ball Valves can be supplied in any material, sizes 2″ through 42″ or larger, at ratings of 150 lb. to 1500 lb. ASA or API working pressures of 960 to 5000 psi. They are available with flanged ends, welding ends, flanged by welding or, in sizes 2″ to 6″, with screwed ends. Any desired type or style of operator can be furnished. Delivery can be made from our factories located in United States, Canada, Mexico, England and France.

CAMERON IRON WORKS, INC. P. O. BOX 1212 HOUSTON, TEXAS

Before Corexit: As many as 16 rod jobs on 9 wells in 1 month

After Corexit: Only 4 rod jobs in any 1 year!*

HUMBLE COREXIT®

CORROSION INHIBITORS

* *COREXIT saves $1,010 per well per year* in one field . . . $780 per well in another . . . has proved highly profitable in thousands of wells. In both sour and sweet crude fields, COREXIT corrosion inhibitors prolong life of sub-surface equipment, reduce well-pulling jobs and prevent production losses . . . usually through simple batch treatment.

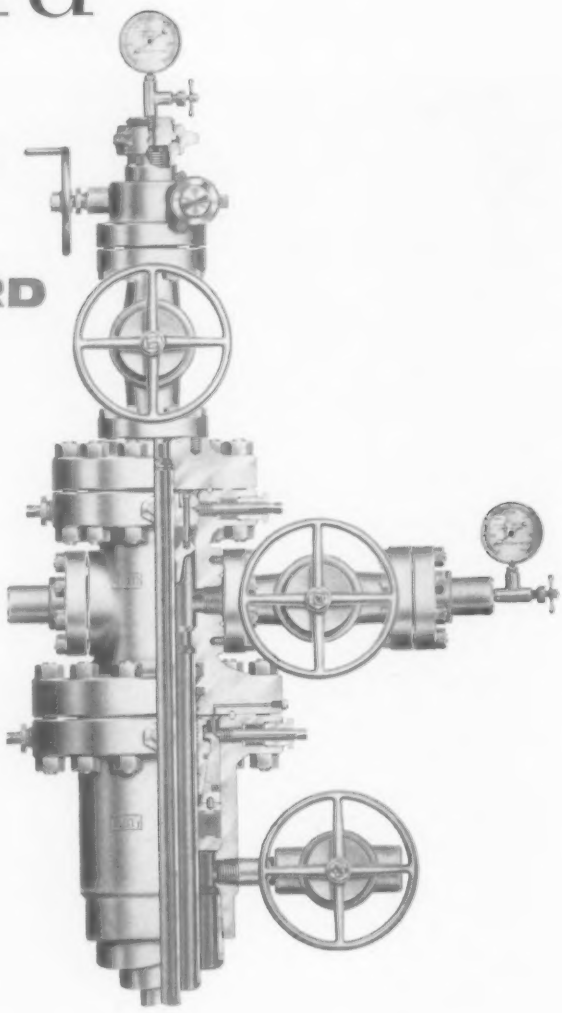
In deep high pressure, high bottom-hole temperature wells, *squeeze treatment* with COREXIT is opening new opportunities for economical corrosion control. Only a few treatments per year are usually required.

Find out how COREXIT can cut your costs. Call your Humble Salesman, or contact Humble Oil & Refining Company, Houston, Texas. COREXIT is available for immediate delivery from Humble Bulk Plants and other marketers.

HUMBLE

America's Leading ENergy COmpany

The O·C·T Standard Tree



STILL THE "STANDARD OF THE OILFIELD"

The O-C-T Standard Tree is a combination of an O-C-T casing head, O-C-T tubing head, master valve of your choice, and an O-C-T flow control.

Thousands of O-C-T Standard Trees are performing in oilfields around the world. The strength, simplicity, and flexibility of the Standard Tree made it the "standard of the oilfield" years ago.

Constant improvements to the O-C-T Standard Tree have made a good tree better. Today, more than ever, informed buyers can say, "There is no better hookup."

where progress is a daily practice

O·C·T

OIL CENTER TOOL CO.

SUBSIDIARY OF FOOD MACHINERY AND CHEMICAL CORPORATION

Address Export Inquiries for All Countries to
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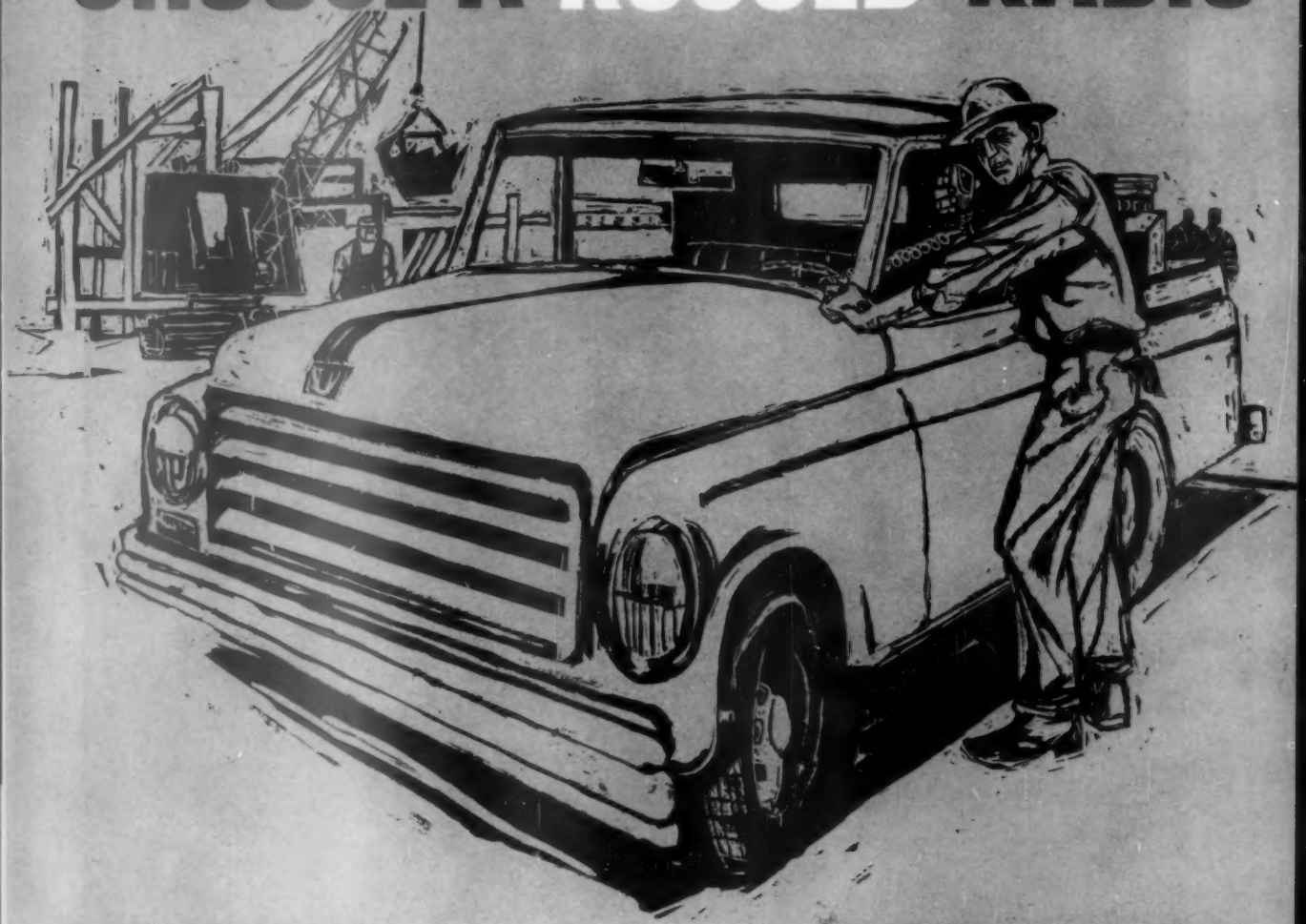
CHOOSE A RUGGED RADIO



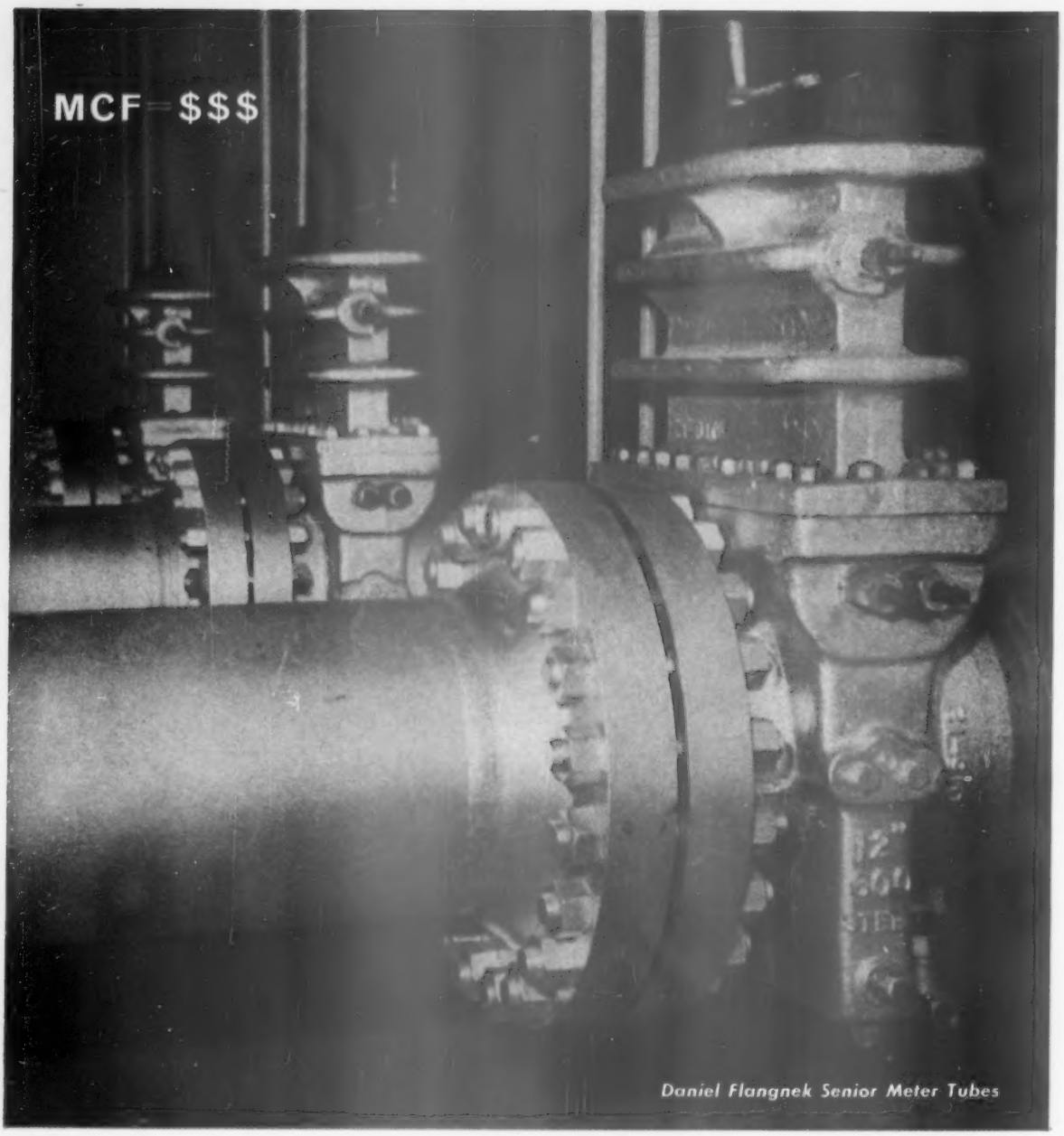
FOR A RUGGED BUSINESS

YOUR TRUCKS GIVE RADIO A BEATING . . . pounding, jolts, jars, and vibrations—but rugged, tough, Motorola 2-way radio keeps right on working. From the solid 18-gauge steel housing right down to each controlled-quality transistor, here's the radio built for the toughest field service.

Examples? Precision tuning coils are friction-threaded and spring-loaded to stay on frequency, even under severe shock and vibration. Critical selectivity circuits are cast in polyesterstyrene, guaranteed for the life of the radio. Every major component is firmly fixed to the chassis, secure against breakaway and "whip" damage. The result? Longer equipment life . . . fewer outages . . . lower maintenance and **lowest communications cost.** For complete information write dept. **AOG 117.**

MOTOROLA
2-WAY RADIO

Motorola Communications & Electronics, Inc.
A Subsidiary of Motorola Inc.
4501 Augusta Blvd., Chicago 51, Ill.



CASH REGISTERS

Natural gas changes hands in a hurry at the orifice meter station. Here is where millions of cubic feet become dollar signs. You expect optimum "cash register" accuracy and performance. You know you'll get just that with Daniel Orifice Fittings and Meter Tubes because they have the closest tolerances and are easiest to operate. Fast delivery, too. In all sizes (2"–36") and pressure ratings (125 lbs.-2500 lbs. ASA), you can depend on Daniel.

DANIEL ORIFICE FITTING COMPANY
P. O. BOX 19097 HOUSTON 24, TEXAS HO 5-3451

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Agents in Principal Cities

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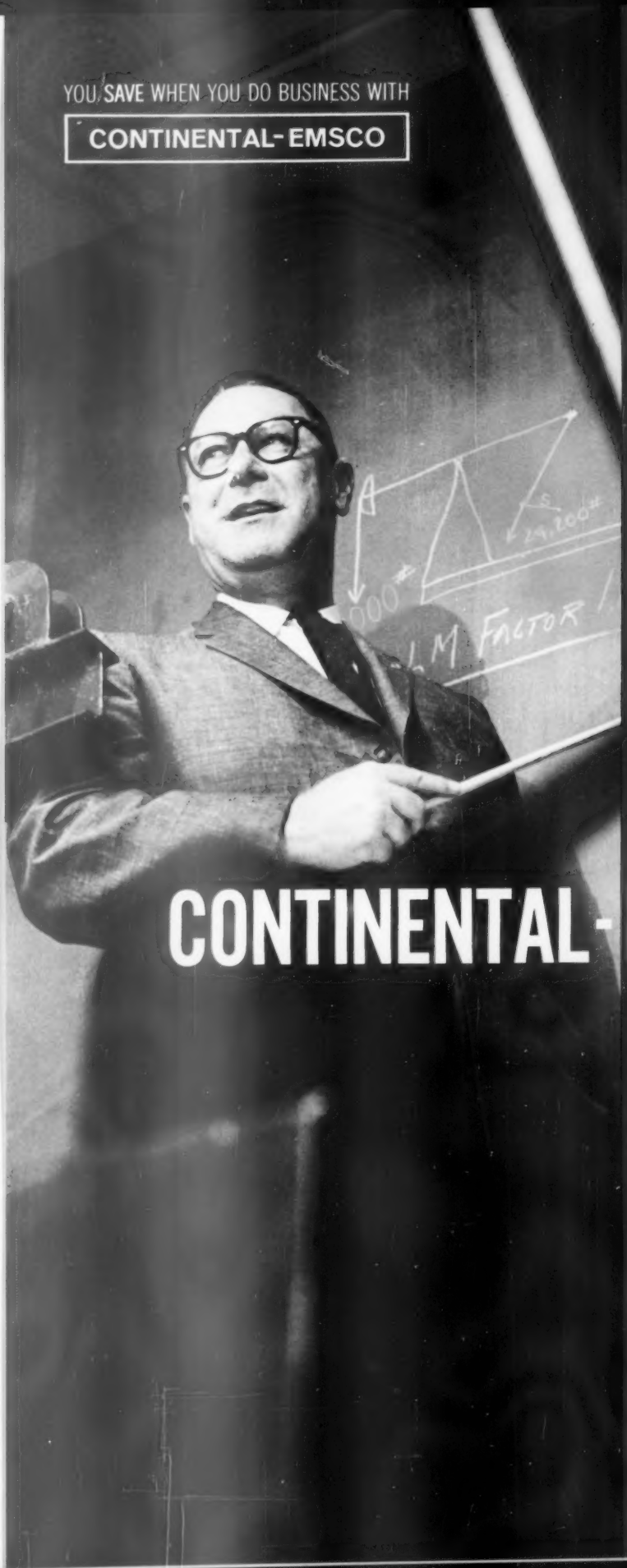
YOU SAVE WHEN YOU DO BUSINESS WITH

CONTINENTAL-EMSCO



LET'S TALK

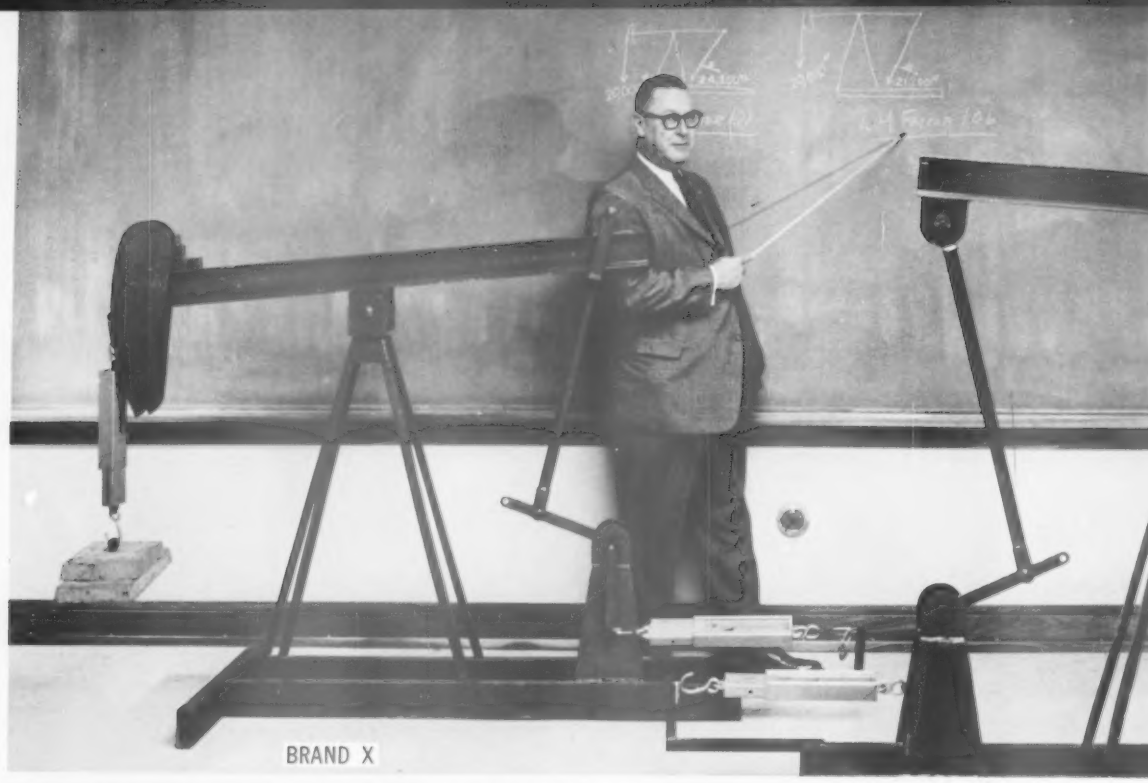
ABOUT CONVERTING LIFTING COSTS INTO

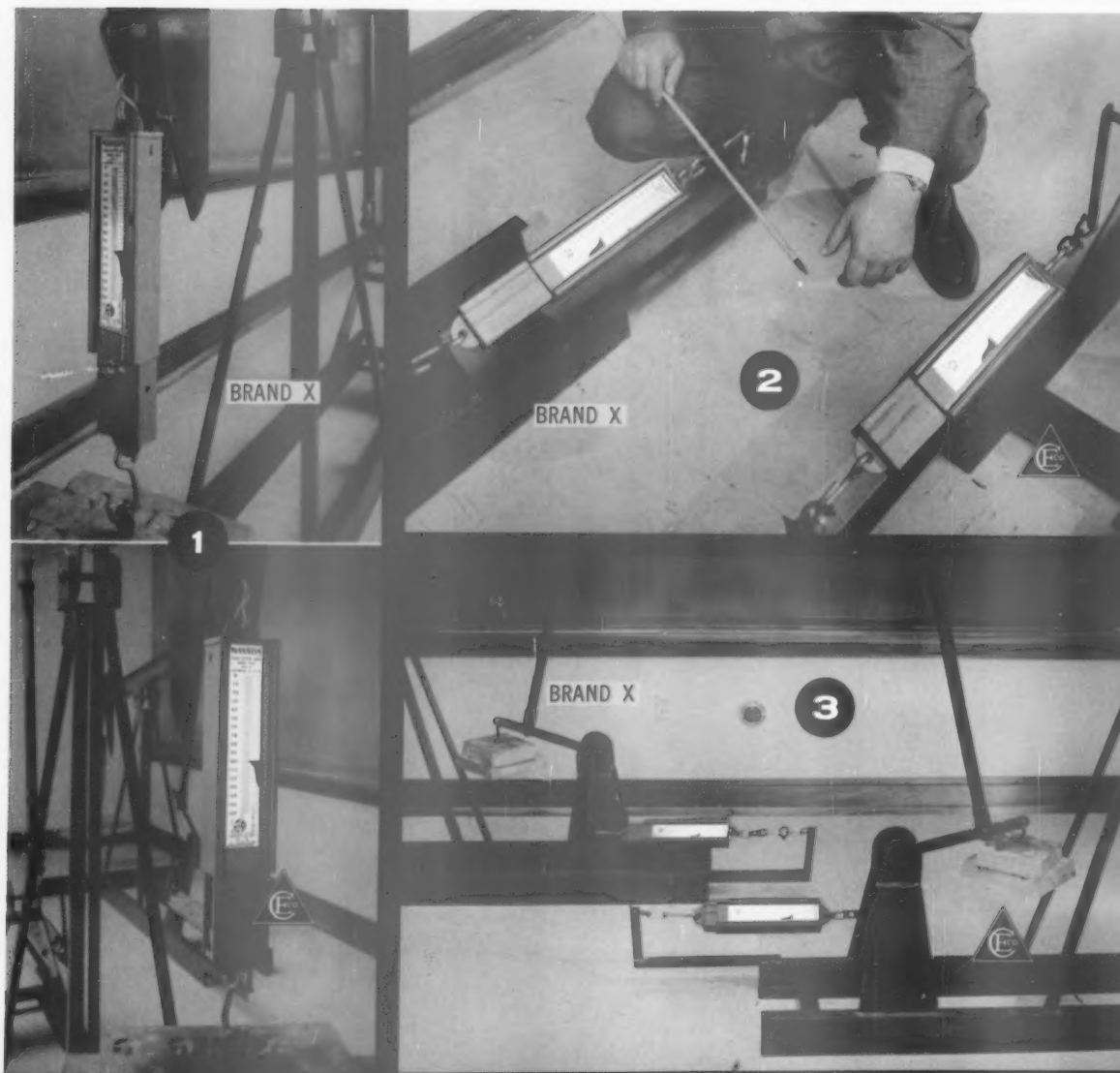
PUMPING PROFITS

WITH

CONTINENTAL-EMSCO UNIT PUMPERS

Designed to meet the API standards


BRAND X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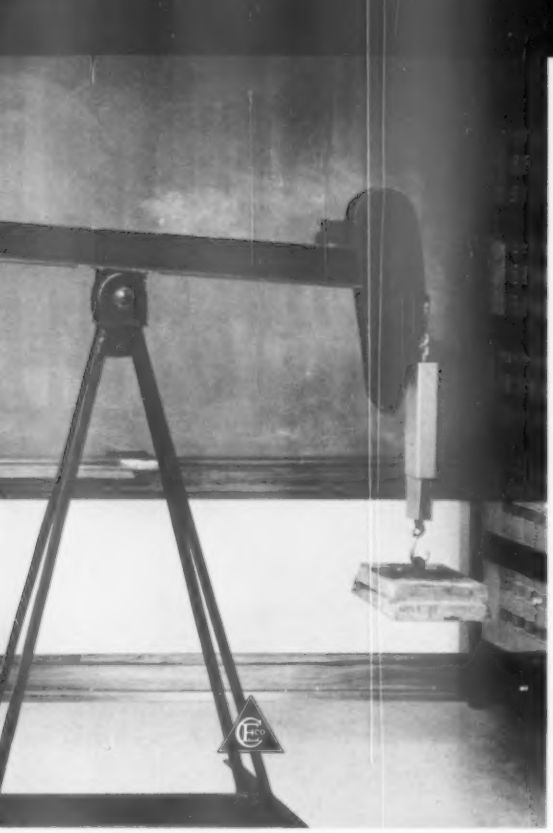


THIS SIMPLE DEMONSTRATION

. . makes it easy to see how C-E's low LMF (Load Multiplication Factor) cuts your operating costs.

See the two model units in the large photograph? The one on the right conforms to Continental-Emsco's design principles. Note its taller samson post. See how its added height reduces the angle between the pitman and a true vertical line. The smaller this angle, the less is your Load Multiplication Factor. This means you're pulling more vertically and more efficiently, as you'll see in the following example:

On the two models shown, a "well load" of 100 lbs. is applied. With the C-E-type model, the wrist-pin load is only 102 lbs. — a 1.02 Load Multiplication Factor. On the brand "X" model, the wrist-pin load is 119 lbs. for a 1.19 LMF. Seventeen pounds difference. Not much? It represents 16.6% more loading than on the C-E-type model.

To illustrate the advantages of good design, this demonstration is slightly exaggerated, to be sure . . but only slightly. Let's examine the figures from typical full-size unit pumpers and see what the LMF actually can mean to you:

On a 20,000 lb. well, a Continental-Emsco unit pumper with its LMF of 1.06 at its maximum stroke will produce a wrist pin load of only 21,200 lbs. Consider a competitive make with a 1.21 LMF actually being sold today. Here the same well load is increased to 24,200 lbs. at the wrist pin . . a ton and a half greater. Imagine the extra wear on gears, the excessive peak loads on purchased electric power, and the undue strain on belts and bearings!

Now you can see why so much time and effort went into the development of C-E's unit pumper design . . *to offer you the industry's lowest Load Multiplication Factor throughout the line.*

If you speak for your company's management, engineering, or purchasing departments, you should investigate the *many profit advantages* you gain with Continental-Emsco unit pumpers. Make it a point to see your C-E representative or write direct.

1

These two close-ups show spring scales on the two models in the large photograph. Both read 100 lbs. "well loads".

2

Spring scales attached to the wrist pins of the two models read: 102 lbs. for the C-E-type model on the right; 119 lbs. for the brand "X" on the left . . . *over 16% greater wrist-pin load.*

3

With the well load remaining 100 lbs., 50 lbs. of actual counter-balance were added to each unit. The net load at the wrist pin on the C-E reads 34 lbs., while brand "X" reads 51 lbs., a 50% greater bearing and torque load. Obviously the efficiency of C-E's properly-designed unit pays off in lower operating costs, less wear on bearings and gear-teeth, and lower power costs —without over-sizing or purchasing added counterbalance effect.

YOU SAVE WHEN YOU DO BUSINESS WITH

CONTINENTAL-EMSCO

LET'S TALK

ABOUT CONVERTING LIFTING COSTS INTO

PUMPING PROFITS

WITH

CONTINENTAL-EMSCO UNIT PUMPERS

Designed to meet the API standards

SUN is another reason why storage tanks should be protected with Pittsburgh's Brilliant White TANKHIDE®!

• **Brilliant White TANKHIDE** is formulated with controlled chalking, self-cleansing white titanium pigments which maintain high solar-heat reflectance and reduce costly evaporation losses of volatile petroleum products.

• **What's more, because of its weather-resistant vehicles,** TANKHIDE possesses remarkable toughness and durability. These qualities result in lower tank maintenance costs and greater protection against weather-wear and corrosion.

• **Want particulars on these advantages?** Wire, write or phone Pittsburgh Plate Glass Company, Industrial Finishes, 1 Gateway Center, Pittsburgh 22, Pa.

PPG®

PITTSBURGH INDUSTRIAL FINISHES

PITTSBURGH PLATE GLASS COMPANY

Engineering Progress Report

FROM UNION CARBIDE CHEMICALS COMPANY

Acetonitrile boosts butylene throughput 58%, saves $3,000,000 capital investment

Unusual solvent useful in saturate-unsaturate and olefin-diolefin separations

By using acetonitrile as an extractive distillation solvent, Shell Chemical Corporation has boosted throughput of the existing butadiene feed-preparation unit 58% in their Torrance plant. Minor engineering changes for the unit cost $148,000: it has been estimated that a similar throughput increase through new construction would cost about $3,000,000. Development work and operating experience have shown that acetonitrile's unusual solvent properties should prove useful in other saturate-unsaturate and olefin-diolefin separation processes.

ADVANTAGES OF ACETONITRILE

Acetonitrile has boosted capacity in the Shell plant because it increases the spread in boiling points of the C_4 hydrocarbons being distilled. Thus, separation of the hydrocarbons is more efficient than with either acetone or furfural. Relative volatility of n-butane compared to butene-1 is about 1.25 with acetone and about 1.30 with furfural. Acetonitrile increases this ratio to almost 1.4. The spread in boiling points of butene-1 and butadiene is also increased. The table gives data on the relative volatilities of C_4 hydrocarbons in aqueous acetonitrile systems.

After the extractive distillation has been completed, acetonitrile can be completely recovered from the butane and butylene streams with greater ease than acetone. This increased recovery efficiency is due to the high distribution coefficient of acetonitrile in water/hydrocarbon systems.

ENGINEERING CHANGES MINOR

Because of the similarity of the physical properties of acetonitrile and acetone, it is not necessary to change the operating pressure of extractive distillation columns. Shell engineers made only minor changes to their unit. Besides a larger reboiler and a new pump, two heat exchangers were switched and the solvent recovery column was connected to vacuum operation. Aqueous acetonitrile systems do not foul exchanger systems. Corrosion due to hydrolysis of solvent at reboiler temperatures is minimized by pH control.

TABLE 1 RELATIVE VOLATILITIES OF THE C_4 HYDROCARBONS IN AQUEOUS ACETONITRILE, 120 psia

Component	Total Solvent Concentration, 80%m		Total Solvent Concentration, 85%m	
	Water in Solvent 15%m	Water in Solvent 25%m	Water in Solvent 15%m	Water in Solvent 25%m
Isobutane	1.638	1.673	1.637	1.674
n-Butane	1.332	1.347	1.348	1.368
Isobutylene	1.013	1.013	1.013	1.013
Butene-1	**1.000**	**1.000**	**1.000**	**1.000**
t-Butene-2	0.861	0.856	0.865	0.861
cis-Butene-2	0.821	0.813	0.827	0.820
Butadiene-1, 3	0.639	0.599	0.645	0.604
Water	0.08	0.045	0.075	0.045
Acetonitrile	0.043	0.033	0.043	0.033

OPERATING COST REDUCTIONS

The butadiene feed-preparation unit operating on acetonitrile has less solvent-loss than one operating on acetone. *Thus, solvent make-up costs are no higher with acetonitrile than with acetone.* Steam and pumping costs have also been reduced because reflux and circulation rates are lower. This is true even at reduced feed rates.

ACETONITRILE USEFUL IN OTHER PROCESSES

Acetonitrile is effective in other saturate-unsaturate and olefin-diolefin separations. This heat-stable extractant is useful in ethylene-ethane, propylene-propane, and cyclopentadiene-cyclopentane separations. The boiling point spreads between pentadienes, such as isoprene, and pentenes are also increased.

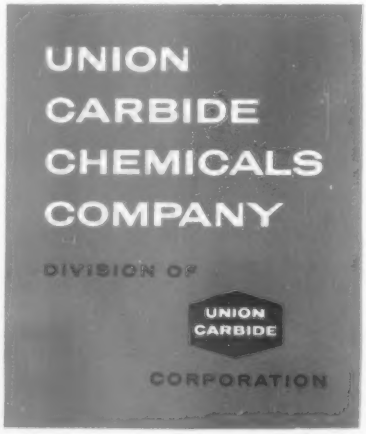
In liquid-liquid extraction processes, acetonitrile is effective in removing tars, phenols, and color bodies from hydrocarbons. Acetonitrile is also useful as a selective solvent for fatty acids.

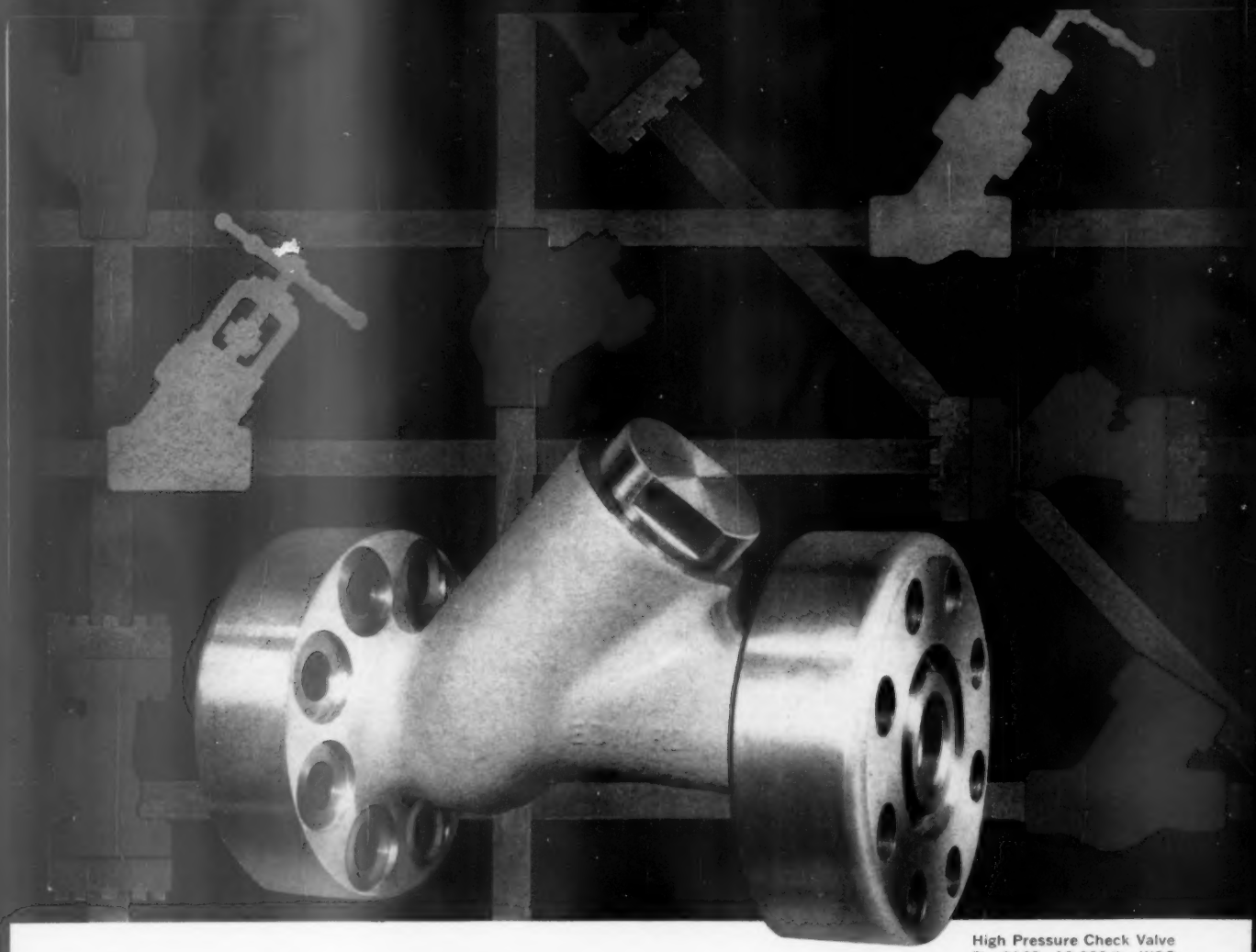
INFORMATION AVAILABLE

If you're looking for increased efficiency in your extractive distillation or liquid-liquid extraction processes, acetonitrile could be the answer. Detailed information on acetonitrile as an extractive distillation solvent along with information on azeotropic mixtures of acetonitrile is available. For this information, call the nearest CARBIDE Technical Representative—or write, Department B, Union Carbide Chemicals Company, 270 Park Avenue, New York 17, New York.

Nothing herein shall constitute a recommendation to practice any invention covered by any patent without permission of the patent owner.

"Union Carbide" is a registered trade-mark of Union Carbide Corporation.

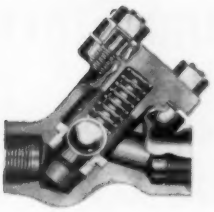




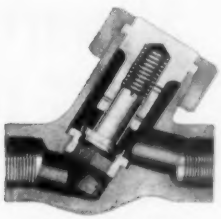
High Pressure Check Valve
Fig. 9160 10,000 lb WOG
Horizontal or Vertical

Edward Check Valves give positive protection against flow reversal

Edward forged steel check valves are built for the rugged duty required in oilfield and refinery piping systems. This complete line of Rockwell-built valves is available in ball or piston type; screwed, flanged, or socket welding ends; union, screwed, bolted, or welded covers for pressures to 10,000 psi, temperatures to 1050F. Field tested interior design assures long life, positive seating with minimum pressure drop. Check valves are available up to 2″ in forged steel. Cast steel piston check valves and tilting disk check valves up to 18″. For details, contact your favorite oilfield supply store or write to Edward Valves, Inc., 1212 West 145th Street, East Chicago, Indiana. Subsidiary of Rockwell Manufacturing Company. 6020



Ball Check Valve
Fig. 4632, Bolted Bonnet
Rating: 600 lb at 900F
(2000 lb WOG)
Horizontal or Vertical



Piston Check Valve
Fig. 3578, Union Bonnet
Rating: 1500 lb at 850F
(3600 lb WOG)
Horizontal or Vertical

Edward Ball Check Valves are recommended for liquid services, especially where heavy, viscous fluids are encountered. Stainless steel ball disk is fully guided and closure is aided by stainless steel springs. Edward Piston Check Valves feature EValloy* 13% chromium stainless steel seat and disk, and Ironkote soft metal gasket for leakproof body-bonnet joint. Stainless steel spring assures positive seating.

*T.M. Reg. U.S. Pat. Off.

EDWARD STEEL VALVES
another fine product by
ROCKWELL

THE MOST SIGNIFICANT

Stewart and Stevenson announces the ALL NEW

NATURAL GAS CONVERSION

FOR GENERAL MOTORS SERIES 71 DIESEL ENGINES

WHY DO WE SAY IT'S THE MOST SIGNIFICANT ENGINE NEWS IN A CENTURY?

BECAUSE

For years there has been a growing demand for a true spark ignited, natural gas burning engine with the flexibility and superior performance characteristic of the General Motors Two Cycle Diesel Engine.

The development by Stewart & Stevenson Services of a Spark Ignition Conversion Kit for this great Diesel Engine offers a world of new advantages to prospective engine users as well as the owners of existing General Motors Diesel applications wherever lower cost, natural gas is available.

Now, you can enjoy **"Jimmy Diesel"** performance, long life and flexibility PLUS the advantage of being able to operate (through a simple conversion) on either Diesel fuel or straight natural gas . . . **WITHOUT OWNING TWO TYPES OF ENGINES.**

General Motors Series 71 Engines equipped with the new Stewart & Stevenson Spark Ignition Conversion operate on natural gas fuel developing full rated horsepower. Furthermore, their acceleration and lugging characteristics are simply amazing.

These new engines equipped for natural gas operation as well as the conversion kits available for older series 71 engines are thoroughly **TRIED AND PROVEN.**

They are the result of thousands of hours of exhaustive research and field testing over a period of more than three years.

Write today for more information on how these new Stewart & Stevenson Services developments can benefit you.

ENGINE NEWS IN A CENTURY

12 NEW SPARK-IGNITED MODELS

FROM 50 H.P. TO 1440 H.P.

MODEL 3SG
Horsepower.....50 to 76
Number of Cylinders.....3
RPM (Continuous Duty).....
.....1200 to 1800
Weight....1600 lbs., approx.

MODEL 4SG
Horsepower.....63 to 107
Number of Cylinders.....4
RPM (Continuous Duty).....
.....1200 to 1800
Weight....1800 lbs., approx.

MODEL 6SG
Horsepower.....100 to 163
Number of Cylinders.....6
RPM (Continuous Duty).....
.....1200 to 1800
Weight....2150 lbs., approx.

MODEL TWIN 4SG
Horsepower.....125 to 212
Number of Cylinders.....8
RPM (Continuous Duty).....
.....1200 to 1800
Weight....5000 lbs., approx.

MODEL 8VSG
Horsepower.....135 to 250
Number of Cylinders.....8
RPM (Continuous Duty).....
.....1200 to 1800
Weight....2550 lbs., approx.

MODEL TWIN 6SG
Horsepower.....200 to 326
Number of Cylinders.....12
RPM (Continuous Duty).....
.....1200 to 1800
Weight....5700 lbs., approx.

MODEL 12VSG
Horsepower.....200 to 360
Number of Cylinders.....12
RPM (Continuous Duty).....
.....1200 to 1800
Weight....3300 lbs., approx.

MODEL 16VSG
Horsepower.....275 to 500
Number of Cylinders.....16
RPM (Continuous Duty).....
.....1200 to 1800
Weight....5800 lbs., approx.

MODEL QUAD 6SG
Horsepower.....400 to 650
Number of Cylinders.....24
RPM (Continuous Duty).....
.....1200 to 1800
Weight....12500 lbs., approx.

MODEL TWIN 12VSG
Horsepower.....400 to 720
Number of Cylinders.....24
RPM (Continuous Duty).....
.....1200 to 1800
Weight....13500 lbs., approx.

MODEL TWIN 16VSG
Horsepower.....550 to 1000
Number of Cylinders.....32
RPM (Continuous Duty).....
.....1200 to 1800
Weight....17800 lbs., approx.

MODEL QUAD 12VSG
Horsepower.....800 to 1440
Number of Cylinders.....48
RPM (Continuous Duty).....
.....1200 to 1800
Weight....26000 lbs., approx.

STEWART & STEVENSON SERVICES, INC.

Main Office and Plant: 4516 Harrisburg Blvd., Houston 11, Texas
Phone CApitol 5-5341
Branches: Corpus Christi, Dallas, Lubbock, San Juan, San Antonio, Beaumont, Odessa
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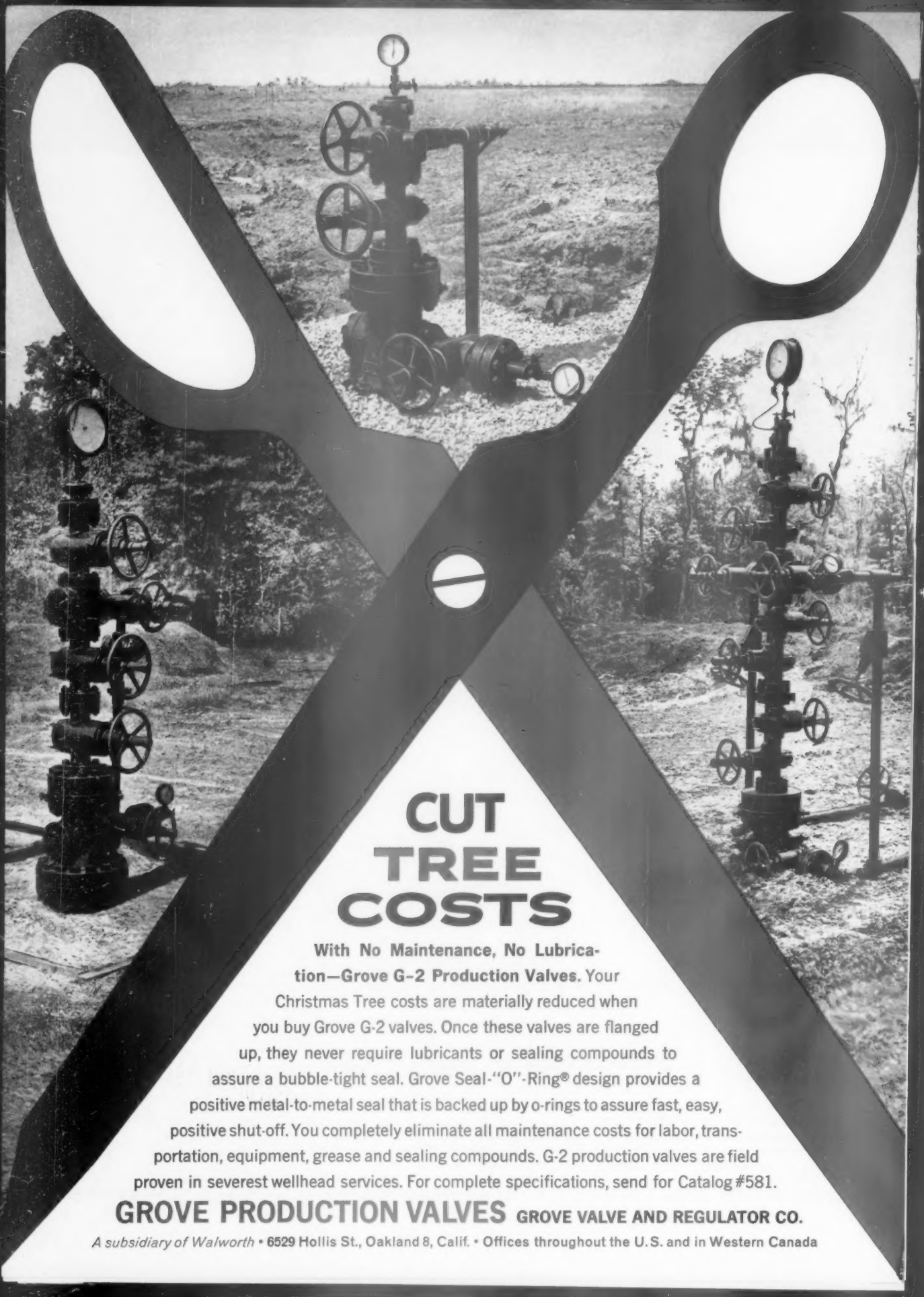
Export: Room 1405, 74 Trinity Place, New York, N. Y.

STEWART & STEVENSON

THE WORLD'S LARGEST DISTRIBUTOR OF DIESEL ENGINES



CUT TREE COSTS

With No Maintenance, No Lubrication—Grove G-2 Production Valves. Your Christmas Tree costs are materially reduced when you buy Grove G-2 valves. Once these valves are flanged up, they never require lubricants or sealing compounds to assure a bubble-tight seal. Grove Seal-"O"-Ring® design provides a positive metal-to-metal seal that is backed up by o-rings to assure fast, easy, positive shut-off. You completely eliminate all maintenance costs for labor, transportation, equipment, grease and sealing compounds. G-2 production valves are field proven in severest wellhead services. For complete specifications, send for Catalog #581.

GROVE PRODUCTION VALVES **GROVE VALVE AND REGULATOR CO.**

A subsidiary of Walworth • **6529 Hollis St., Oakland 8, Calif.** • **Offices throughout the U.S. and in Western Canada**

Hole Enlarging

This is just one of the three *families* of Grant Tools made for reaming, hole enlarging and stabilizing. For full information on these, and a wide range of other down-hole and surface tools made by Grant, send for your copy of the complete Grant Catalog today, or see the Grant section of Composite Catalog!

You can get from Grant!

Every hole enlarging job presents its own special set of conditions. That is why Grant, with more experience in this highly specialized field than any other manufacturer, has engineered specific tools for *your* particular job. For opening rat-holes . . . enlarging hole for the casing string . . . under-reaming before cementing—in any well—Grant's 30 years of specialization have produced the right tool for the job at hand.

When hole enlarging is your requirement, *remember that only Grant makes and services all types of hole enlargers in active oil territory everywhere!*

GRANT OIL TOOL COMPANY

2042 EAST VERNON AVENUE, LOS ANGELES 58, CALIFORNIA
Cable Address: GRANTOOL

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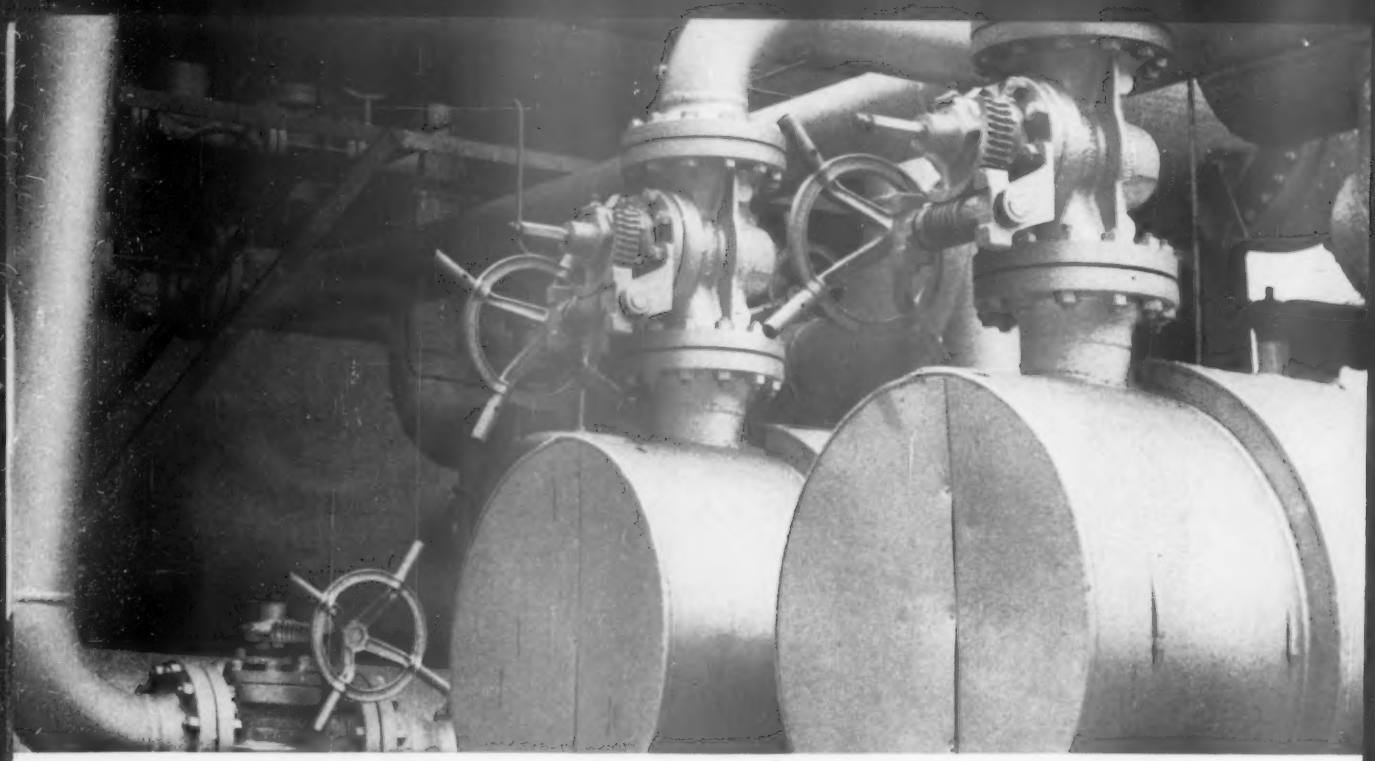


K-51 (Penton) coated Rockwell-Nordstrom valves resist attack by a wide range of corrosive refining fluids.

SPECIAL COATINGS CUT VALVE COSTS

Now, Rockwell-Nordstrom lubricated plug valves are available with special coatings to solve a wide number of corrosion problems that used to require costly special alloy valves.

K-51 (Penton) plastic coatings give iron or steel Rockwell-Nordstrom valves an exceptional corrosion resistance against attack by most acids, caustics and organic-inorganic solvents . . . Kanigen (metallic nickel) coatings assure the corrosion resistance of nickel or stainless steel . . . and Teflon coated plugs assist lubricant efficiency on services where inadequate or infrequent lubrication is anticipated. Whatever your valve needs, for the most difficult services or the easiest ones, the *complete* line of Rockwell-Nordstrom lubricated plug valves can fill your needs better and at lower cost. Write for complete details: Rockwell Manufacturing Company, Pittsburgh 8, Pa. Canadian Valve Licensee: Peacock Brothers Limited. Rockwell International S.A., Geneva, Switzerland.

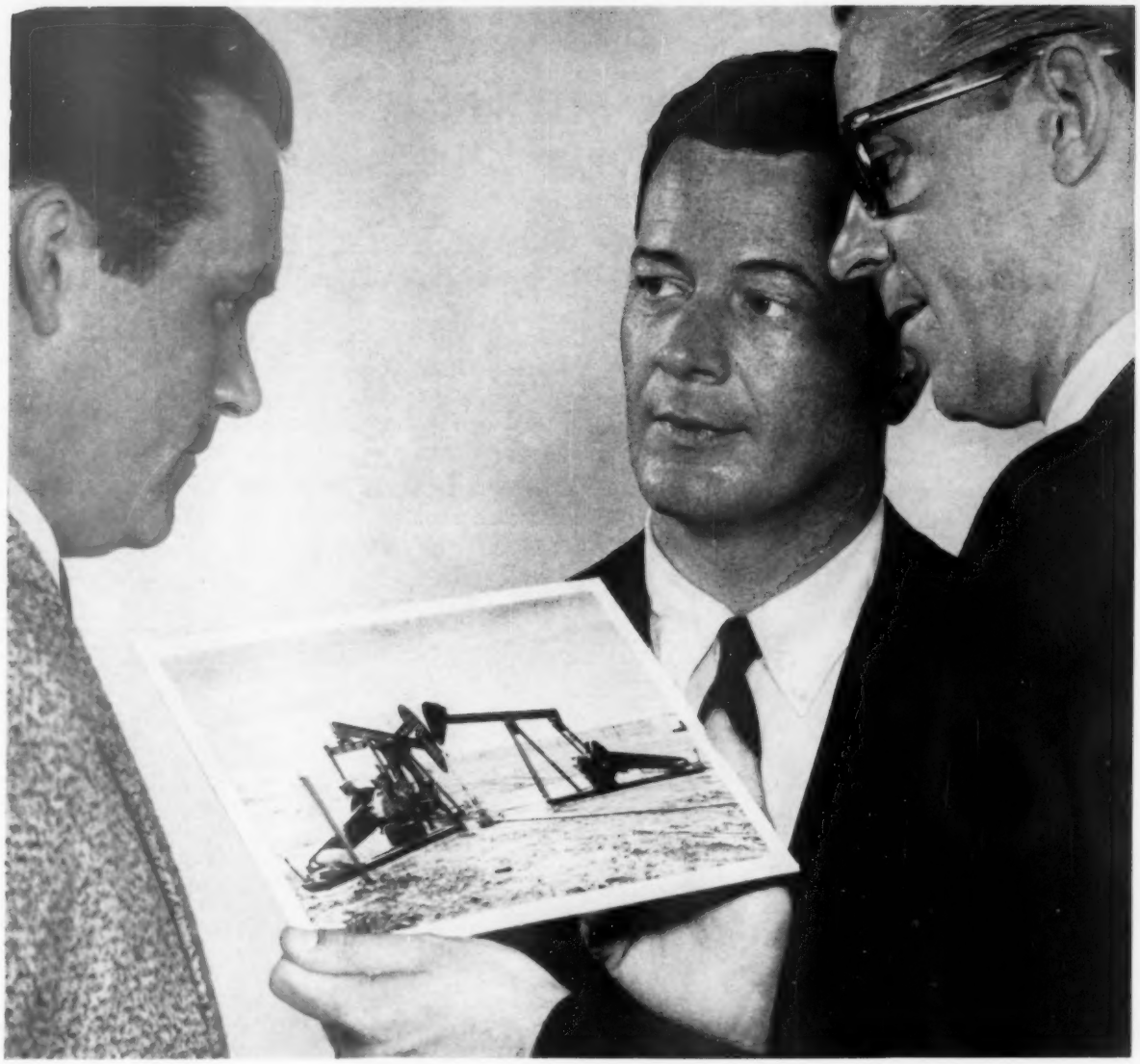
Lubrication Makes The Difference

ROCKWELL-Nordstrom VALVES

another fine product by

ROCKWELL

At tank farms, Rockwell-Nordstrom valves with Teflon coated plugs insure longer performance and instant operation at points remotely located from plant.

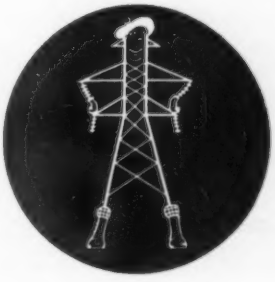


3 heads are better than 1 . . .

Often a utility electric power company engineer enters into a decision with one or more oil company engineers . . . effecting the economy of operation. This assistance is available anytime to oil producers, pipeline personnel or refinery engineers. As a matter of interest the triple pumper in the photograph pumps simultaneously from three producing zones.

Petroleum Electric Power Association
BOX 35006, DALLAS 35, TEXAS

Utility Electric Power saves money, manpower, maintenance and serves you better automatically



A list of P.E.P.A. members will be furnished on request

NOT EVERY TIMEPIECE HAS 21 JEWELS

You couldn't wear this or hang it on the wall, but at 2,000 or 20,000 feet underground there's nothing better. This clock gives you precise timing for the most accurate drill stem test record available. It's an important part of the Johnston "T" and "M" recorders. Ever hear of them?

No Swiss watch could be more accurate than these recorders. Just to give you an idea: plus or minus 1/3rd of 1% variation in high well temperature and pressure. Pressure changes of 2½ pounds are clearly visible on Johnston charts, 3 times bigger than other D.S.T. charts.

Here's why you get recordings that assure the most accurate interpretation possible—a special, pre-heat-set clock spring for consistency, teflon piston seal for friction-free travel, high unit deflection for preciseness and a spring mechanism that won't break under pressure.

One Johnston recorder was purposely dropped more than 1,000 feet. Bull nose was broken but the recorder still worked properly. Another example why Johnston equipment gives an accurate account of your well.
Think about it, then call us.

JOHNSTON TESTERS

Houston, Texas • Calgary, Canada

"Made OF Stainless Steel ...Made BY Jenkins"

Valve Performance Shows the Big Difference in that Spec!

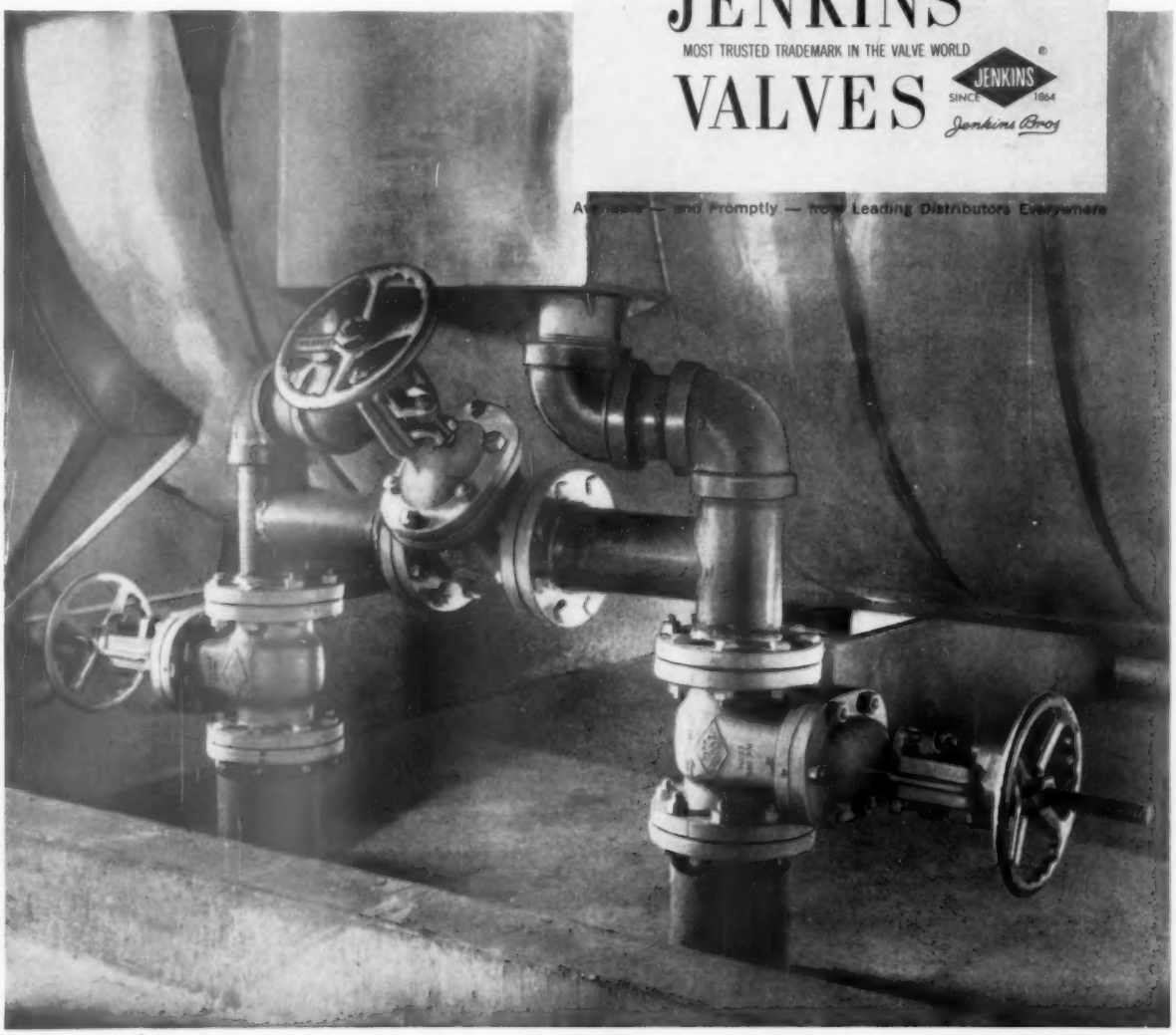
When service conditions require valves of Stainless Steel, remember that metal is only part of the answer to long, dependable valve performance.

The WAY valves are made is equally important. Factors you can't even see make a big difference. Such factors as *perfection of castings . . . precision machining . . . painstaking inspection and testing . . . sound design.* Most important of all: *the maker's guiding policy about quality.*

To be sure about all these critical factors, experienced specifiers and buyers specify JENKINS as well as the metal alloy when Stainless Steel valves are needed. It is well-known that for almost a century Jenkins has made valves to *just one* standard of quality . . . the highest. At Jenkins every operation, every worker is aimed at fulfilling that standard, whatever metal a valve is made of.

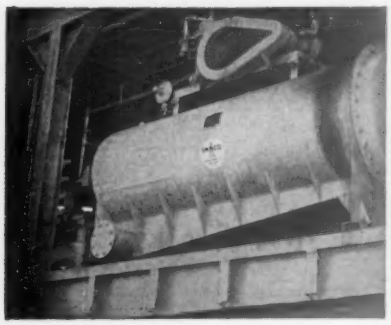
SEND FOR NEW CATALOG 59-SS of Jenkins Stainless Steel valves in types and alloys to satisfy most needs. Jenkins Bros., 100 Park Ave., New York 17.

JENKINS
MOST TRUSTED TRADEMARK IN THE VALVE WORLD
VALVES
JENKINS SINCE 1864 Jenkins Bros



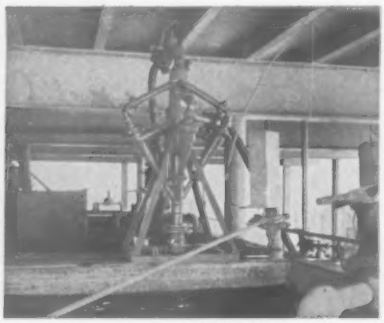
Three good ways to cut drilling costs

The three units shown here are important items behind the recent revolution in drilling fluids that has done so much to speed drilling and cut costs. Each is designed for a different problem but all are efficient and economical. Equally important, all are handled by SWACO -- the leader in mud-treating equipment.



SWACO D-GASSER®

Operators frequently report saving the entire rental cost of a D-Gasser on a well in less than a day.
When mud is gas-cut, the D-Gasser saves money in many ways. It cuts time lost for circulating after trips. It reduces barite costs, it minimizes lost circulation costs and problems. It maintains mud pump efficiency and it actually makes possible the close control of mud weight and viscosity that results in faster drilling with increased safety.



CLAYJECTOR®

If you are using mud as heavy as 12 pounds per gallon, you can cut mud costs and increase drilling rate by using a Clayjector. This is a cyclone-type separation unit that is extremely effective at rejecting unwanted clays and retaining expensive barite.
In addition, since it makes possible the economical maintenance of a low-solids, low-viscosity mud, it actually permits a reduction in bit costs and drilling time.

D-SANDER®

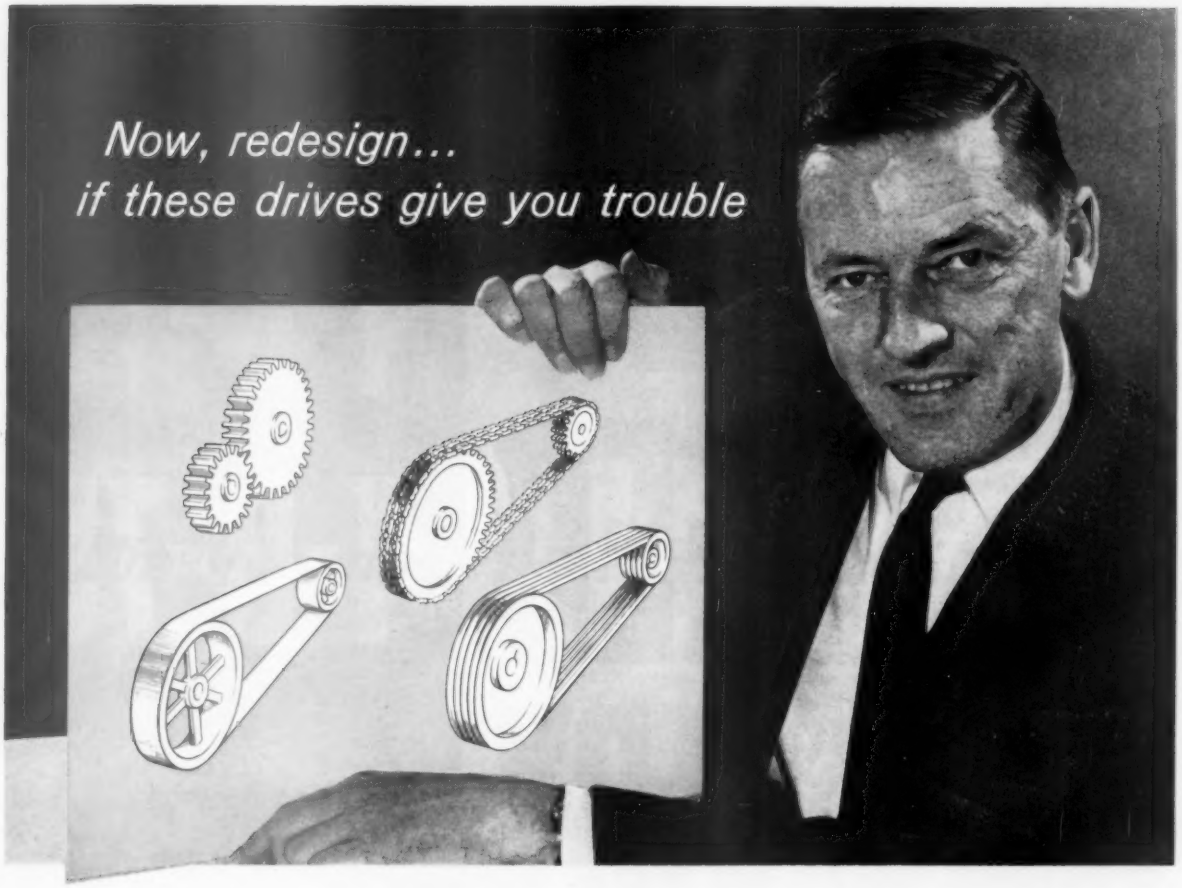
The D-Sander greatly increases the life of mud pump parts and bits when sand or abrasive shale is being drilled. Since it removes virtually all sand-sized solids from the mud, excessive pump-parts and bit-nozzle wear — as well as many other problems — are avoided when a D-Sander is used. There is a size and type to fit every rig and drilling condition.

These descriptions tell just a few of the many ways you can cut costs by mechanical mud treating. For the full story on how you can profit, call your nearest SWACO representative or write us direct.

SWACO

SALT WATER CONTROL, INC.
1809 CONTINENTAL NATIONAL BANK BLDG., FORT WORTH 2, TEXAS
Telephone: EDison 2-4433 Cable Address: "SWACO" Fort Worth

LOUISIANA: New Orleans, Lafayette
OKLAHOMA: Oklahoma City
TEXAS: Houston, Corpus Christi, Fort Worth, Kermit
COLORADO: Durango



Ask your local Gates Man to show you how Super HC Drives reduce machine down-time

If you have a chain, gear, flat belt or even a conventional V-belt drive that is causing costly production down-time or high maintenance costs, your local Gates Man will be glad to help you. He will show you how these troubles can be ended by using a Gates Super HC V-Belt Drive—the first and most advanced High Capacity drive.

Because of exclusive design features, Gates Super HC V-Belts handle up to 3 times the horsepower of conventional V-belts in the same space—or they can often handle the required horsepower in about half the space. Fewer belts are needed, and sheaves can be smaller and lighter weight. As a result, bearing loads are less, increasing bearing life, reducing maintenance costs.

Gates Super HC Drive is quiet, smooth-running and entirely dependable—multiple belts assure you of continuous operation, ending costly production losses. It is a highly resilient drive that protects your machine from vibration and damaging shock loads, increasing machine life and lowering maintenance costs—savings that often amount to many times the cost of the drive.

The Gates Man located near you is a drive design expert. Contact your nearby Gates-stocked oil field supply house for his help when you have a drive problem.

BP41P

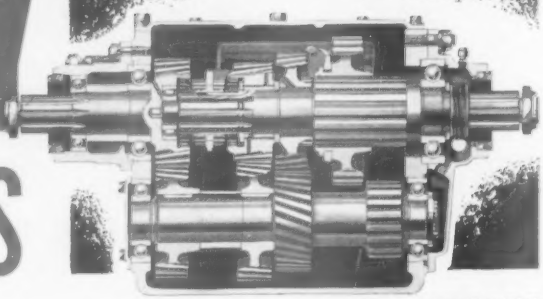
The Gates Rubber Company, Denver, Colorado

Gates Super HC V-Belt Drives

NEW 4-SPEED AUXILIARY TRANSMISSIONS

For Medium-Heavy-Duty Trucks and Tractors

MODELS 4-B-73 AND 4-B-75



SPLIT GEARS AND *GO*...SHIFT INTO DEEP REDUCTIONS AND *PULL*

You no longer have to pay a premium price for a 4-speed auxiliary which is heavier than your operation demands. Save weight *and* money with one of the new Fuller 4-speed Auxiliaries equipped with overdrive, direct, low and low-low gear ratios in one compact, 375-pound unit. Get gear-splitting ratios plus deep reduction.

The Fuller 4-B-73 is designed for use with engines producing approximately 500-600 lb./ft. of torque. Use of special high-capacity bearings permits the 4-B-75 to be used with engines in the 600-700 lb./ft. torque class.

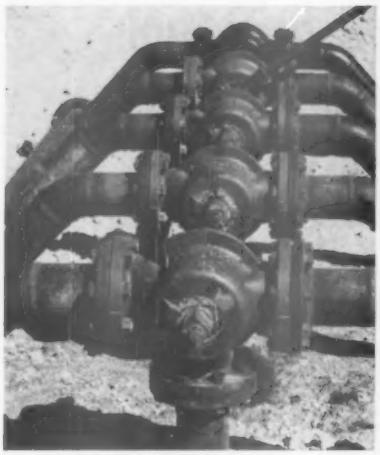
Get all the extras of price, performance and payload. Specify the new Fuller 4-B-73 or 4-B-75 4-speed Auxiliary Transmissions. For full details, see your truck dealer or write Fuller Manufacturing Company.

GEAR RATIOS
Models 4-B-73 and 4-B-75

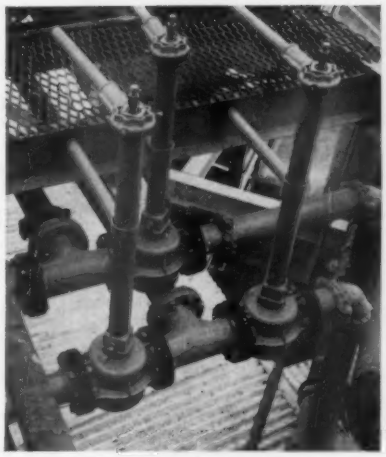
Overdrive	.85
Direct	1.00
Low	1.24
Low-Low	2.22

FULLER TRANSMISSION DIVISION
EATON MANUFACTURING COMPANY
KALAMAZOO, MICHIGAN

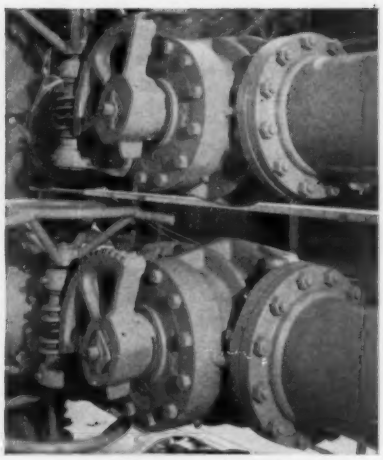
Sales & Service: West. Dist. Branch, Oakland 6, Cal. • Southwest Dist. Office, Tulsa 3, Okla. • Automotive Products Co., Ltd., Brock House, Langham St., London W.1, England, European Rep.



Oilfield Service



Uranium Processing

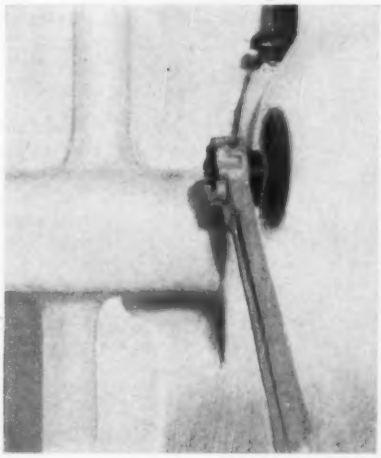


Cement Manufacturing

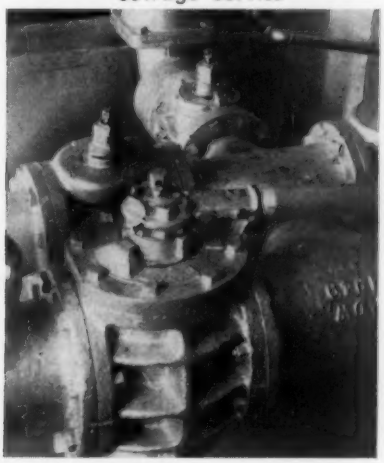
When so much depends on a valve...

Chemical Processing

Air Conditioning



Sewage Service



Specify the non-wedging cylindrical plug: W-K-M's ACF® Lubricated Plug Valve

This unique valve meets critical dependability requirements because the plug is *cylindrical*. It *can't wedge* . . . can only *rotate*, like a journal in a well-lubricated bearing. Result? Smooth quarter-turn operation that makes the ACF plug the workhorse of industry. It handles gases, liquids and abrasive slurries — all with outstanding dependability and economy. And port-size for port-size, ACF Lubricated Plug Valves are competitive in price. Find out more . . .

WRITE FOR CATALOG 400

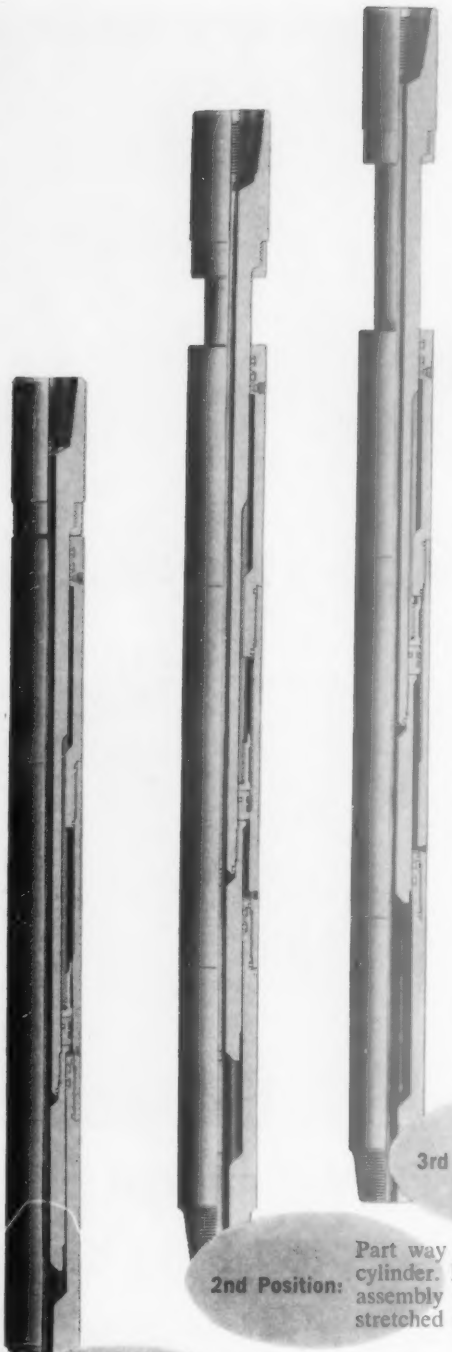
ACF LUBRICATED PLUG VALVES are available in round, rectangular, diamond and V-ports; also in venturi, multi-port and steam-jacketed models. Sizes: ½" through 30"; Working Pressures 125 through 800 lbs.

W-K-M

DIVISION OF ACF INDUSTRIES INCORPORATED

P. O. BOX 2117, HOUSTON, TEXAS

6010



For Positive Operation, Long Life and Trouble-free Service use

Bowen HYDRAULIC ROTARY JARS

Here is a straight-pull jar that can be depended upon to deliver a blow of any intensity—from a light tap to the maximum impact that can be withstood by the run-in string. Even more important, it is easily controlled from the surface—no need to take up torque—no surface pre-setting. The impact intensity and frequency are easily and simply controlled by the operator by elevating the drill string at the speed required to strike a blow of the desired intensity.

Key to the outstanding performance is the patented Bowen Seal Ring Assembly which consists of Non-Extrusion Rings, Seal Protector Rings and "O"-Rings. The Seal Ring Assembly enables the Bowen Hydraulic Rotary Jar to withstand extreme differential pressures without failure.

Bowen Hydraulic Rotary Jars have been proved through years of use under all conceivable conditions. They have operated successfully at depths as great as 20,000 feet and temperatures above 390° F. Write for full information.

3rd Position: At the upper limit of piston motion, the full energy potential stored in the drill string is available to jar the fish. The intensity of the blow is perfectly controllable, and the jar is easily reset by just setting the weight of the drill string on the jars.

2nd Position: Part way up, the piston enters the fluted section of the cylinder. Resistance to motion drops, and the jar's inner assembly is greatly accelerated by energy stored in the stretched drill string.

1st Position: This drawing shows the jar in the closed position. The piston in the cylinder is in the lowermost position. Piston rings seal between cylinder and piston to retard movement until desired tension is taken on the drill string.

Available from your service company domestically:

Sold through supply stores for export.

BOWEN ITCO, INC.

P. O. Box 4587

Houston 13, Texas, U.S.A.

Cable Address: ITCO

BOWEN

Dayco CORPORATION

Dayton Industrial Products Co. Div. Melrose Park, Illinois

ONE CALL DOES IT...

PROBLEM:

Your Rotary Hose breaks. Or is about to break. You have no replacement on hand. How can you cut downtime to the absolute bone?

SOLUTION:

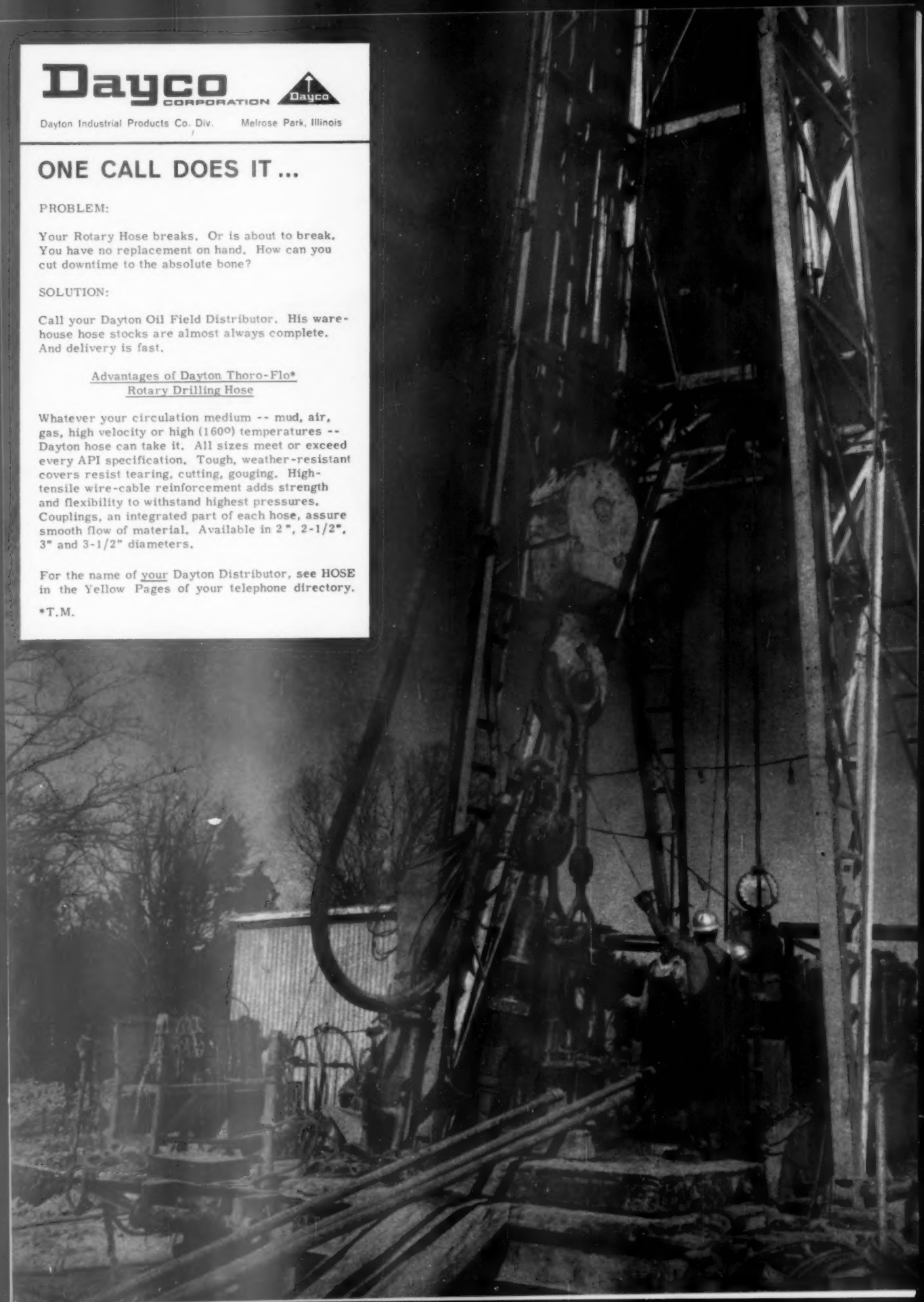
Call your Dayton Oil Field Distributor. His warehouse hose stocks are almost always complete. And delivery is fast.

Advantages of Dayton Thoro-Flo* Rotary Drilling Hose

Whatever your circulation medium -- mud, air, gas, high velocity or high (160°) temperatures -- Dayton hose can take it. All sizes meet or exceed every API specification. Tough, weather-resistant covers resist tearing, cutting, gouging. High-tensile wire-cable reinforcement adds strength and flexibility to withstand highest pressures. Couplings, an integrated part of each hose, assure smooth flow of material. Available in 2", 2-1/2", 3" and 3-1/2" diameters.

For the name of your Dayton Distributor, see HOSE in the Yellow Pages of your telephone directory.

*T.M.



CHEVROLET

SEEN IN ALL THE WORST PLACES

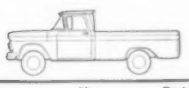
They keep showing up in places most trucks can't get to because it takes an awful lot to stop these sure-footed Chevy four-wheel-drive models! Where the job calls for the mobility of a mountain goat teamed with the stamina of a mule, you'll find no finer way to get your work done. And for 1961 the Chevrolet 4-wheel drive lineup is a full dozen models long. You can pick from a *wide* selection—one that's sure to include the best answer to your toughest traction-plus requirement!

■ Put any one of these 4-wheel drive Chevies on any job—then watch it dig in and *go!* Come what may in the way of mud, snow, sand, loose gravel, creek bottoms, swampland or freshly plowed ground, you can rest assured that the extra bite of up to double traction—plus stump-jumping road clearance—will get you through every time.

And you'll like the way a Chevy 4x4 rolls down the highway in smooth 2-wheel drive, ready to give you 4-wheel traction at the flick of a lever, the moment you need it. You'll appreciate the no-clutch shifting ease of the transfer case (whether moving or standing still) and the extra versatility that's yours with a choice of 4-wheel direct or underdrive.

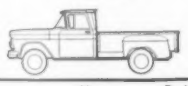
If you prefer the extra snap of spirited V8 power, it's yours at nominal extra cost in any model. Also available at extra cost are heavy-duty 3-speed and 4-speed transmissions and a wide choice of traction tires. You can tailor your Chevy 4 x 4 to fit your needs exactly. Get the full details and turn your traction problems over to Chevy—the traction champ of them all!... Chevrolet Division of General Motors, Detroit 2, Michigan.

FLEETSIDE



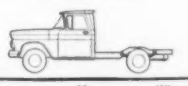
Model	Max. Load	Body Length
K1434	1400 lb.	6½′
K1534	1300 lb.	8′
K2534	2950 lb.	8′

STEPSIDE



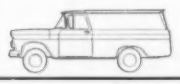
Model	Max. Load	Body Length
K1404	1450 lb.	6½′
K1504	1350 lb.	8′
K2504	3050 lb.	8′

CHASSIS-CAB



Model	Max. Load	Wheel-base
K1403	1900 lb.	115″
K1503	1850 lb.	127″
K2503	3500 lb.	127″

PANEL



CARRYALL

Model	Max. Load	Body Type
K1405	1300 lb.	7½′ Panel
K1406	1000 lb.	Carryall (panel type rear doors)
K1416	1000 lb.	Carryall (tailgate and liftgate)

SEND COUPON TODAY

PLEASE SEND COMPLETE INFORMATION ON THE CHEVROLET 4-WHEEL DRIVE LINEUP TO:

Name_____

Company_____ No. of trucks owned_____

Address_____

City_____ Zone_____ State_____

Fill out and mail coupon to:
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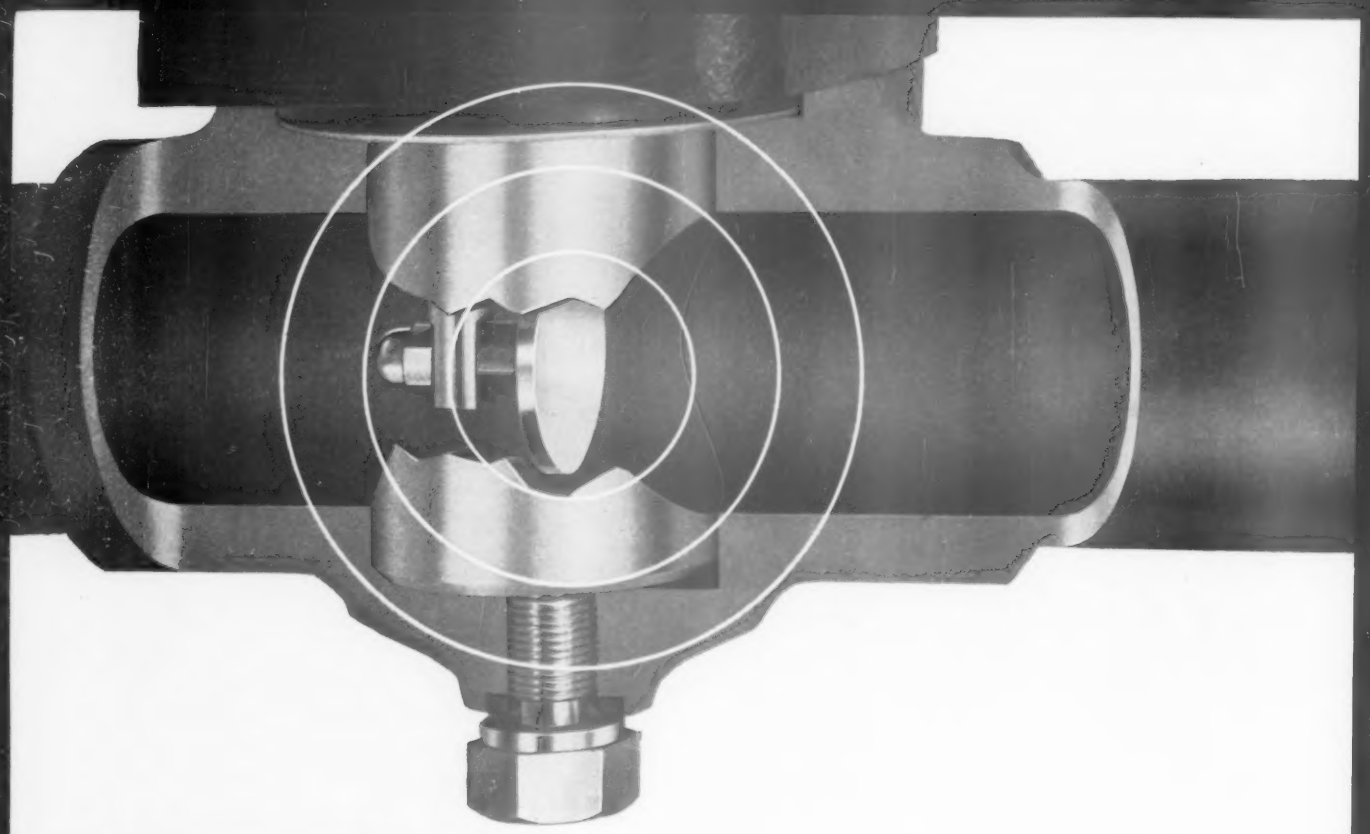
Chevrolet Motor Division
General Motors Corporation
Detroit 2, Michigan

33

1961 CHEVROLET STURDI-BILT TRUCKS

CHEVROLET



improved way to high measurement repeatability . . . the Foxboro Target Flow Meter

designed for the "tough ones"... hydrocarbons, heavy oils, and viscous liquids up to 750 F – installs directly in line . . . no pressure taps to foul or plug up – high repeatability – low maintenance – write for TI 37-84a, or contact your Foxboro Field Engineer.

The Foxboro Target Meter is installed directly in the flow line. A stainless steel "target," extending into flow stream, senses force of fluid pushing against it. Force is then converted to a pneumatic signal and transmitted to a remote Foxboro recorder or controller.

FOXBORO

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They Say—

Enlightening Stopple Job

Dear Sir:

Your February 20 article on the Sahara stopple job ("On the Job Pipelining," p. 155) was read with keen interest by ToPaz, Inc., personnel.

Certainly your step by step presentation will do much to enlighten the industry on a service which has proved safe and economical for many years.

Dell S. Nunally
ToPaz, Inc.
Houston

Dear Sir:

I enjoyed your excellent article about the SOPEG tie-in job in the Big Yellow Book of February 20 (p. 155).

J. B. Smith
Pipe Line Development Co.
Cleveland

Article was catalyst

Dear Sir:

Your article covering the Chama basin in New Mexico (OGJ, Jan. 16, 1961, "Shallow Drilling, Large Blocks Prompt Operators to Check Chama Basin," by Kenneth Chasteen, p. 122) was so interesting and complete it motivated me to move a little farther east and lease an approximate 32,000 acres in the Las Vegas basin of San Miguel County.

Our geologist seems to think this is a fine area for wildcat drilling. The main project, of course, would be the Pennsylvania rocks reached at about 5,000 ft.

Thomas H. Moore
Hobbs, N. M.

Other side of the penny

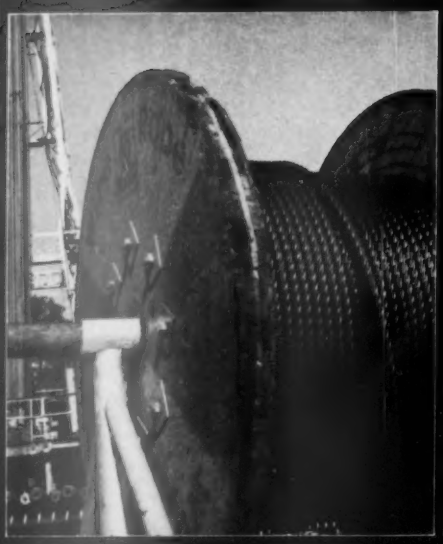
Dear Sir:

Your publication in The Oil and Gas Journal of March 27 of the letter by John E. Husted (p. 42) which discusses Henry D. Ralph's Journally Speaking "Pennies From Harvard" (OGJ, Feb. 13, p. 41), prompts me to regret my negligence

J.L.

SUPPLY

Facts For Drillers



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in failing to reply to that Journally Speaking.

Had I done so promptly, your readers, Mr. Husted among them, might have been alerted to the fact that the column hardly represented a fair summary of my testimony before the Federal Power Commission regarding the predictability of industry-wide success rates.

The Journally Speaking column states that eastern gas distributors take the position that risk in wildcatting is no greater than in any other kind of business. To my knowledge, this position has never been taken by any eastern distributor. It is certainly not the position I have taken.

My testimony does not attempt to measure risk, but rather to demonstrate that whatever is the risk of wildcatting, it is reduced, in the sense that the outcome becomes more predictable, as the size of the exploratory program increases. This conclusion, I submit, is neither novel nor contrary to industry experience and practice.

The column goes on to "quote" data from one of my tables. Aside from the fact that the data are incorrectly quoted, Mr. Ralph neglects to point out that my calculations specifically assume **average** experience and are used as illustrative of the basic principle that predictability increases (i.e., risk decreases) as the size of the exploratory program increases.

I take no responsibility for the research of the unnamed "Harvard professor" to whom Mr. Ralph alludes. If his conclusion is, indeed, that the chances are pretty slim that every individual wildcatter will get one strike out of nine tries," I agree wholeheartedly. I am certain, however, that these chances improve as the number of wells drilled increases.

Mr. Husted's allusions to "intradisciplinary" and "interdisciplinary" fallacies, I fear, are the result of an "undisciplined" desire to jump into print.

Mr. Husted's cryptic allusion to light bulb statistics is a classic example of a non-sequitur—a fallacy that every student of elementary statistics learns to avoid during the early weeks of his course of study. I might suggest to Mr. Husted that when he gets a chance to read my testimony, he note that the key to

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predictability is not the size of the average itself, but rather its stability over time.

I do not deny that at some future time the parameters upon which we base predictions may change because of the depleting nature of this resource. When they do change, and if they do so in a consistent fashion, risk will not necessarily increase, although costs may.

Mr. Ralph, I suspect, wrote his column with "tongue in cheek." Perhaps it amused many of his readers. This doesn't disturb me even if the fun is at my expense. I am disturbed, however, when it evokes replies such as that by Mr. Husted.

Jules Joskow
Director of Research
Boni, Watkins, Jason & Co.
New York

Letters to They Say should be addressed to The Editor, The Oil and Gas Journal, Box 1260, Tulsa, Okla.

CALENDAR

APRIL

24-26 Southern Gas Association, meeting, New Orleans.

24-27 American Association of Petroleum Geologists, Society of Economic Paleontologists, and Rocky Mountain section of AAPG, annual meeting, Denver Hilton Hotel, Denver.

26-28 American Petroleum Institute, Division of Transportation, pipeline conference, Chase-Park Plaza Hotel, St. Louis.

27-28 Rocky Mountain Oil and Gas Association, midyear meeting, Northern Hotel, Billings, Mont.

28 Natural Gasoline Association of America, Oklahoma regional meeting, Lake Murray Lodge, Ardmore, Okla.

29 American Institute of Chemical Engineers Oklahoma state meeting, University of Tulsa, Tulsa.

30-May 2 Independent Petroleum Association of America, midyear meeting, Roosevelt Hotel, New Orleans.

30-May 3 Liquefied Petroleum Gas Association, convention and trade show, Conrad Hilton Hotel, Chicago.

MAY

2-4 Purdue University, School of Civil Engineering, sixteenth industrial-waste conference, Purdue Memorial Center, Lafayette, La.

3-5 American Petroleum Institute, Division of Production, Rocky Mountain district meeting, Gladstone, Henning, and Townsend hotels, Casper, Wyo.

4-5 Society of Petroleum Engineers of AIME, oil recovery conference, Midland, Tex.

4-5 Pacific Coast Gas Association, Inc., transmission conference, Biltmore Hotel, Santa Barbara, Calif.

4-5 Illinois State Geological Survey, Illinois Basin chapter of AIME's Society of Petroleum Engineers, bien-

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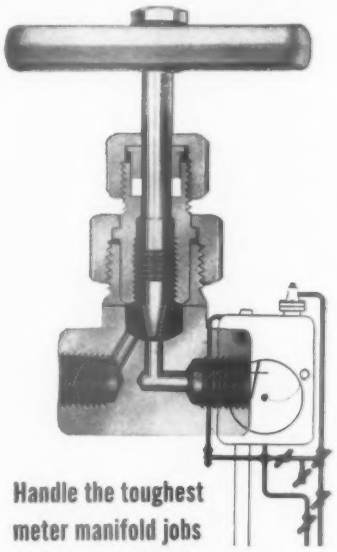

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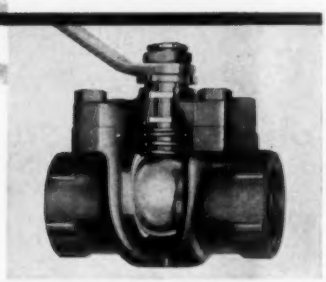

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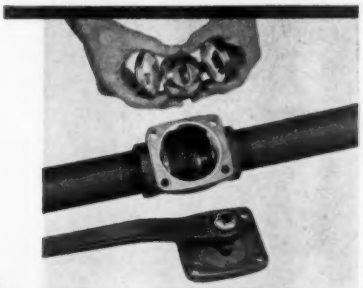

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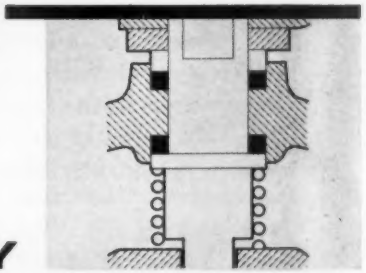

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nial petroleum engineering conference, University of Illinois campus, Urbana.

5-7 Indiana Geological Survey, Indiana Department of Conservation, University of Indiana department of geology, tenth geologic field conference, stratigraphy of the Silurian rocks of northern Indiana, Marion, Ind.

7-10 American Institute of Chemical Engineers meeting, Sheraton-Cleveland Hotel, Cleveland.

8-11 American Petroleum Institute, Division of Refining, midyear meeting, Rice Hotel, Houston.

8-12 American Gas Association, distribution and production conference, Sheraton Hotel, Philadelphia.

9-11 Western Joint Computer Conference and Exhibit, Ambassador Hotel, Los Angeles.

10-12 American Society of Mechanical Engineers, production engineering conference, Royal York Hotel, Toronto.

10-12 Canadian Institute of Mining and Metallurgy, oil and gas division, and Calgary and Edmonton petroleum engineering sections of Canadian Institute of Mining and Metallurgy and American Institute of Mining, Metallurgical, and Petroleum Engineers, annual meeting, McDonald Hotel, Edmonton, Alta.

11 Panhandle Producers and Royalty Owners Association, annual meeting, Herring Hotel, Amarillo, Tex.

11 Texas Petroleum Research Committee, thirteenth oil recovery conference, Memorial Student Center, Texas A & M College, College Station, Tex.

11-12 American Petroleum Institute, Division of Production, Pacific Coast district meeting, Biltmore Hotel, Los Angeles.

11-12 Texas A. & M. College, thirteenth oil recovery conference, College Station, Tex.

12 Natural Gasoline Association of America, Permian basin regional meeting, Lincoln Hotel, Odessa, Tex.

14-17 Texas Independent Producers and Royalty Owners Association, Scharbauer Hotel, Midland, Tex.

16-19 American Petroleum Institute, Division of Marketing, midyear meeting, Americana Hotel, Miami Beach.

17-19 Western Petroleum Refiners Association, Mid-Continent regional technical-industrial relations meeting, Hotel Lassen, Wichita.

17-19 Society of Professional Well Log Analysts, second annual meeting and logging symposium, Sheraton-Dallas Hotel, Dallas.

21-24 American Petroleum Institute, Division of Transportation, midyear highway conference, Bellevue Stratford Hotel, Philadelphia.

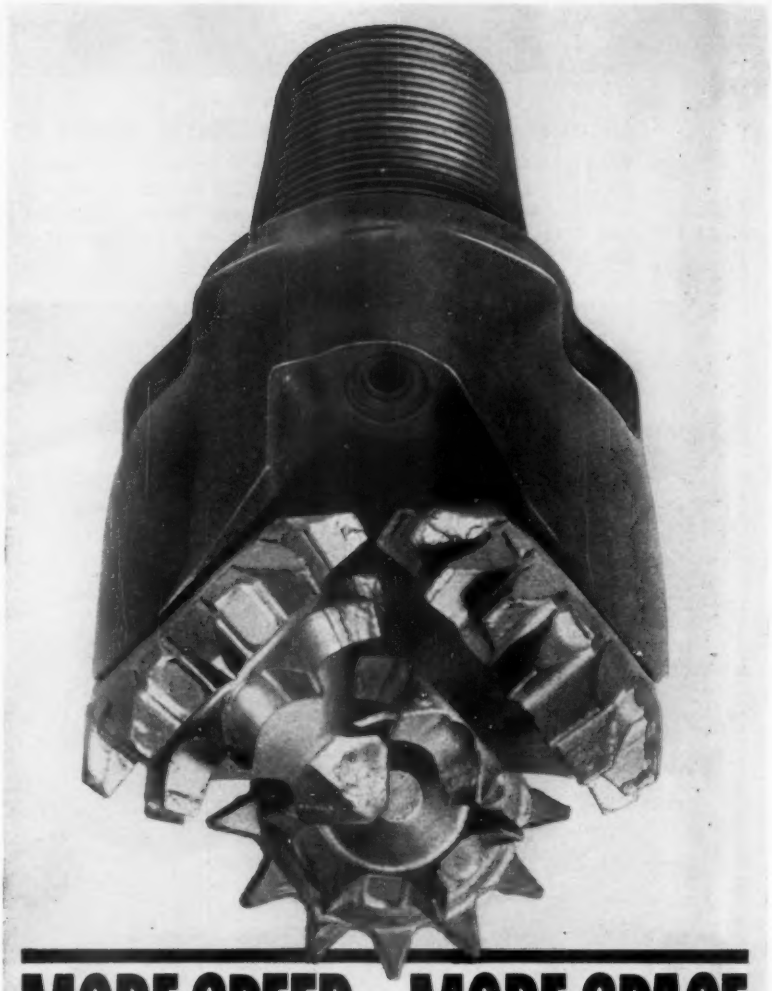
22-25 Design Engineering Show, Detroit, Mich.

24-25 Western Petroleum Refiners Association, computer conference, Ben Franklin Hotel, Philadelphia.

25 Pennsylvania Grade Crude Oil Association, Bradford District Pennsylvania Oil Producers Association, joint annual meeting, Pennhills Club, Bradford, Pa.

25-26 American Institute of Mining, Metallurgical, and Petroleum Engineers, annual Rocky Mountain petroleum sections, joint meeting, Farmington, N. M.

25-26 American Gas Association, gas transmission conference, Brown Palace



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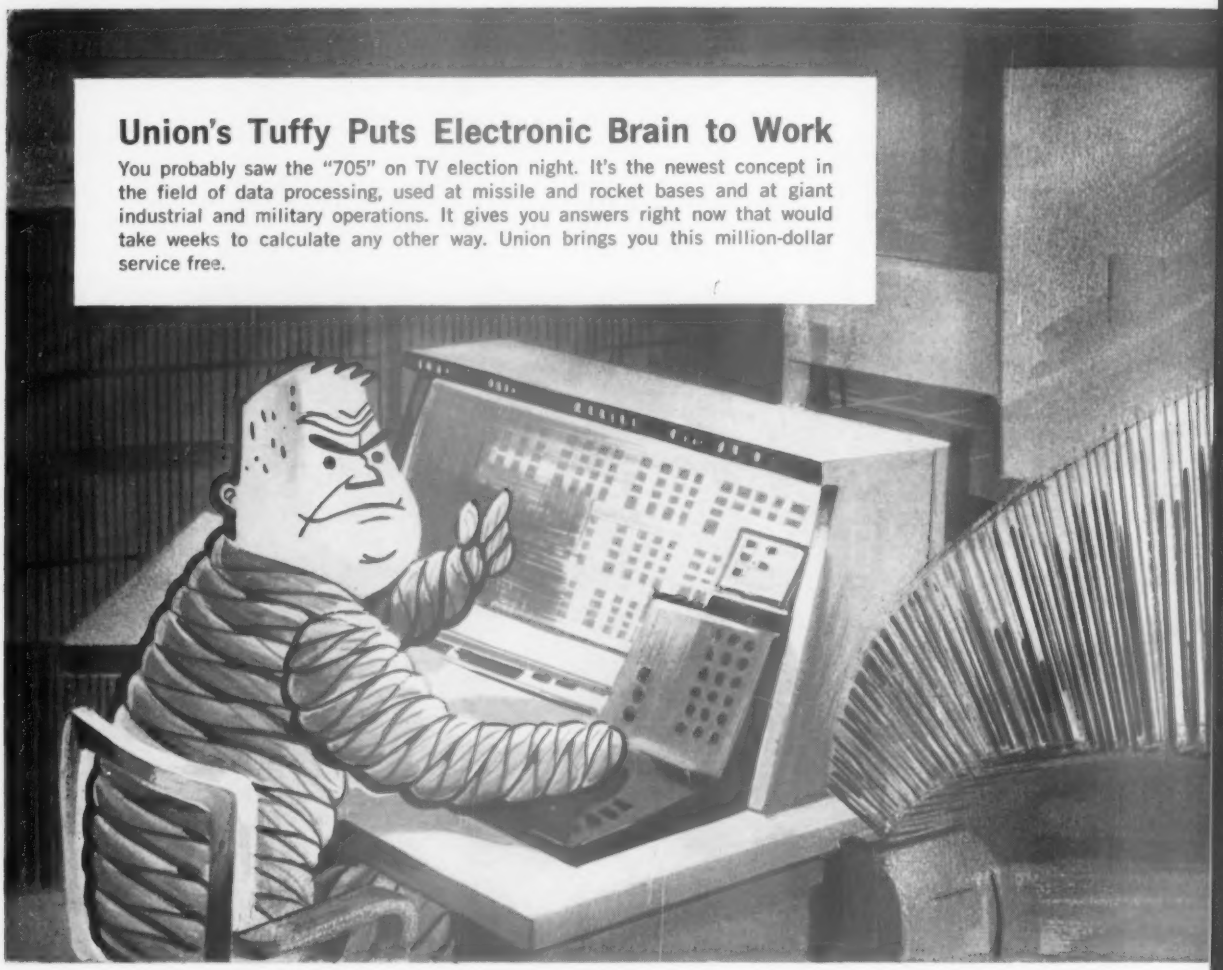
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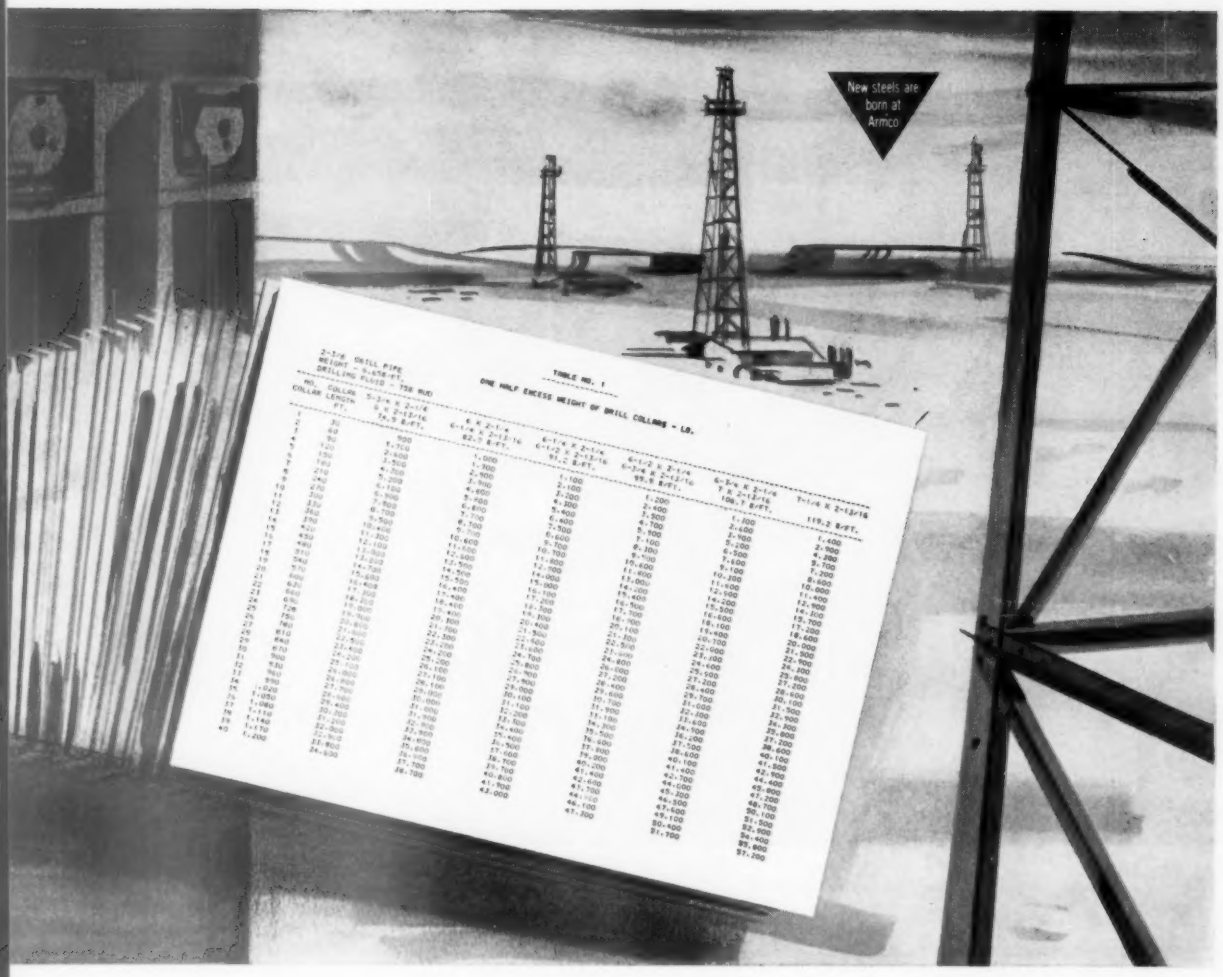

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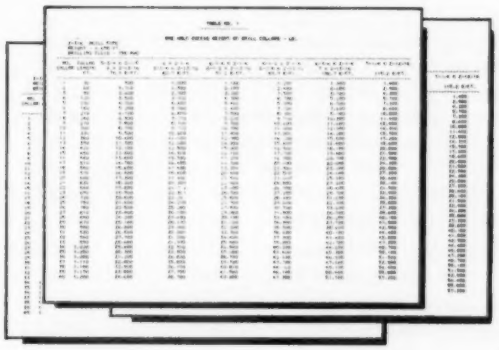

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28-June 2 Special Libraries Association, petroleum section meeting, San Francisco.

JUNE

1-2 Kentucky Oil and Gas Association, annual meeting, Phoenix Hotel, Lexington.

1-3 Interstate Oil Compact Commission midyear meeting, Shamrock - Hilton Hotel, Houston.

5-6 Petroleum Electric Power Association, meeting, Mayo Hotel, Tulsa.

6-8 Instrument Society of America, summer instrument - automation conference and exhibit, Royal York Hotel and Queen Elizabeth Hall, Toronto.

6-8 Sixth annual Appalachian underground corrosion short course, West Virginia University, School of Mines, Morgantown, W. Va.

9-17 European Congress of Chemical Engineering and Achema Congress, thirteenth exhibition and congress of chemical engineering, Frankfurt am Main, Germany.

11-15 American Society of Mechanical Engineers, summer annual meeting, Statler Hilton Hotel, Los Angeles.

11-16 American Petroleum Institute, Division of Production, midyear committee conference, St. Francis Hotel, San Francisco.

12 Instrument Society of America and Air Pollution Control Association, air pollution instrumentation symposium, Hotel Commodore, New York City.

12-14 American Petroleum Institute, Division of Transportation, annual tanker conference, Oyster Harbors, Cape Cod, Mass.

12-16 Gordon Research Conferences, petroleum, Colby Junior College, New London, N. H.

13-16 Instrument Society of America, biennial international gas chromatography symposium, Kellogg Center, Michigan State University, East Lansing, Mich.

19-23 Harvard University, School of Public Health, air cleaning institute, Cambridge, Mass.

19-23 Gordon Research Conferences, catalysis, Colby Junior College, New London, N. H.

20-24 Canadian Gas Association, annual meeting, Banff Springs, Alta.

22-24 American Association of Petroleum Landmen, annual meeting, Shamrock Hilton Hotel, Houston.

25-30 American Society for Testing Materials, annual meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

26-27 Michigan Gas Association, annual meeting, Grand Hotel, Mackinac Island, Mich.

26-July 7 Massachusetts Institute of Technology, summer program on dynamics and control of chemical engineering processes, Cambridge, Mass.

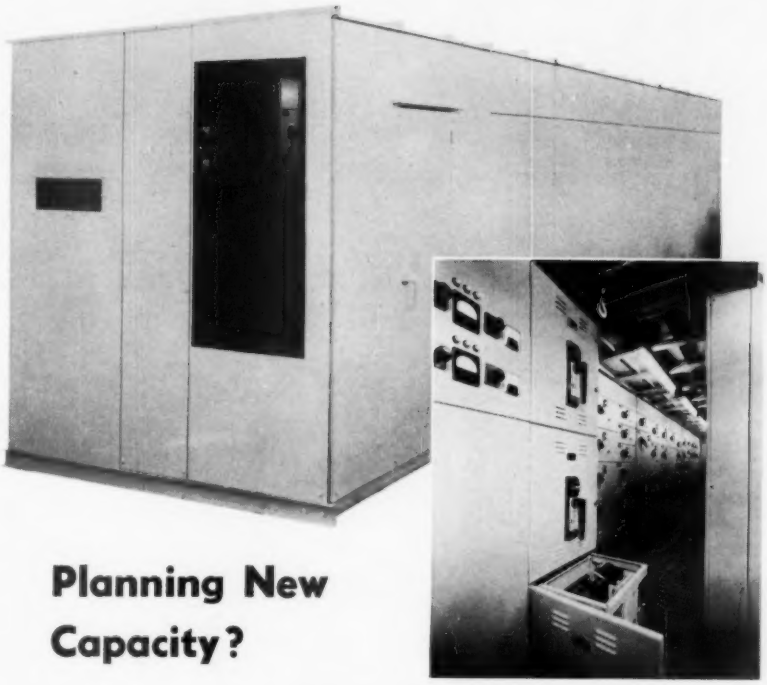
28-30 International Gas Conference, Stockholm, Sweden.

28-30 Instrument Society of America, joint automatic control conference, Boulder, Colo.

JULY

4-7 National Society of Professional Engineers, twenty-seventh annual meeting, Olympic Hotel, Seattle.

6-8 International Oil Scouts Association, annual meeting, Roosevelt Hotel, New Orleans.



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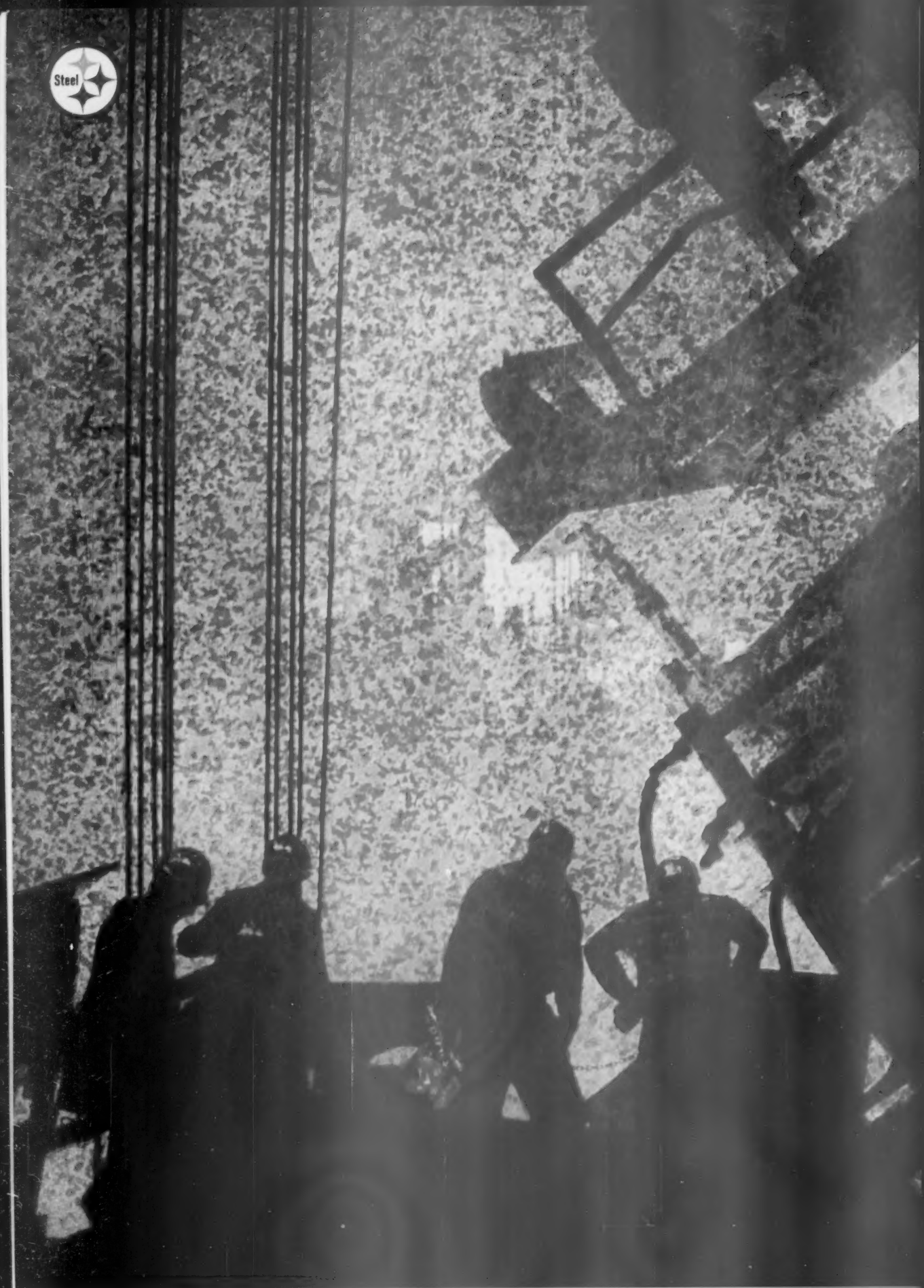
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PHOTOGRAPH BY PAUL WELLER

Number 5 of a Series
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No bargains in this basement!

Drill bits are already digging four miles into the ground, but there are no bargains to be found this deep in the earth's "basement." The average cost of drilling a 5,000 foot well is $50,000. A well three times as deep costs more than *fifteen* times as much — $765,000.

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JOURNALLY SPEAKING

50 years ago

April 27, 1911

Oil men foresee a possible new large market for petroleum products in the development of a gasoline traction plow now being tried out for the first time by Lewiston Orchards Co. on a 5,000-acre fruit farm in Idaho. The plow is powered by an 80-hp. gasoline engine, and operated by two men—an engineer and a plow tender.

Sipsey Valley Co.'s new gas well in the Fayette area of northwestern Alabama is shut down pending the arrival of another car of coal to fire the boilers for further operation. In the same area, Providence Oil & Gas Co. reports the completion of another gas well conservately estimated good for 2,500 M.c.f.d.

The country's oil interest, centered for some time on Oklahoma fields, Caddo, in northwestern Louisiana, and the Gulf Coast, shifted the past week to the live play developing in the Carlyle area of Illinois, and the new Schwartz discovery near Perrysville, just north of Greater Pittsburgh, in Allegheny County, Pennsylvania.

25 years ago

April 23, 1936

New drilling boom hits Oklahoma City field following opening of extension area within the city limits north of state capitol. More than 150 active operations reported. Opening of additional city areas for drilling proposed in coming election.

More than 8,500 acres of producing oil properties in the rich, booming Rodessa field of northwestern Oklahoma change hands in two major oil deals. R. W. Norton, Shreveport operator, sells 5,500 acres of his holdings to Magnolia Petroleum Co. for $10,000,000 and other considerations. Standard Oil Co. of Louisiana acquires Haynes Producing Co., Inc., with 3,000 acres, 35 producing wells, 5 drilling wells, and 133,000 bbl. of stored oil.

10 years ago

April 26, 1951

Rush for leases in the Williston basin develops into a three-state play following Amerada Petroleum Corp.'s discovery of first commercial oil production in North Dakota at its I Clarence Iverson wildcat near Tioga, in Williams County. Major companies buy 25,000,000 acres in North Dakota, and move across state lines into eastern Montana and northwestern South Dakota.

Texas Railroad Commission boosts state's allowable production for May to record high of 2,936,323 bbl. daily. Newly released report reveals world crude-oil production jumped to record high level of 11,382,000 bbl. daily during February.

Shell Oil Co. acquires large site at Woodbridge, N. J., for proposed new East Coast refinery.

Pennies from AAPG

WE STIRRED UP quite a hornet's nest with our February 13 column on "Pennies from Harvard." Brickbats have been coming from all sides.

In this issue (Page 41) is a letter from Dr. Jules Joskow, whom we accused (falsely, he says) of telling FPC that gas producers don't need a high rate of return or any special price incentive because the risks in wildcatting can be reduced to a mathematical certainty.

That column also apparently jarred the AAPG into revising its annual wildcat tabulation, as revealed in a news scoop in Frank Gardner's column on Page 205.

For years AAPG has been talking about the "success ratio" of new-field wildcats, and its tabulations showed a rather consistent record of one success out of nine wells drilled. This statistic gave some theorists (if not Dr. Joskow then it was a couple of other fellows) the idea that if you need 10 new gas fields all you have to do is drill 90 wells, and there is no need to worry about the supply of gas for the future.

The trouble was with the word "success." To a geologist a well is successful if it has enough of a show to justify setting pipe. Then he's through with it and goes off somewhere else to sit on another drilling well.

But to the operator a well isn't a success unless it produces enough oil and gas to pay for itself and also for those eight dusters. And to a gas consumer wildcatting isn't a success unless it discovers enough new reserves to keep him cooking with gas for the rest of his life.

What the AAPG figures failed to show was the number of technically successful wildcats that were abandoned after a short production test, or were marginal stinkers that never paid off.

So now AAPG has checked back on its figures to see how many wildcats discovered worth-while reserves. On this basis the success ratio is more like 1 in 60 than 1 in 9. Unfortunately it takes about 6 years to determine whether a technically successful wildcat is also a success in what really matters—new reserves.

This contribution from AAPG should be a lot more valuable to FPC than all the attempts of mathematics professors at Harvard or elsewhere to develop a theory of probabilities in wildcatting based on experiments in pitching pennies.

What we tried (apparently too obliquely) to do in that "Pennies from Harvard" piece was to suggest that such things as binomial theorems, however accurate, are pretty remote from FPC's vital problem, i.e., fixing a price for gas high enough to assure a future supply.

We have our own probability theory about that problem.

Our theory is that if FPC and the courts don't quit horsing around with the pricing rules there is a very strong probability that a lot of producers are going to say the hell with it and quit wildcatting for gas.

And we are delighted to see that our probability theory is excellently substantiated by the series of short but highly significant articles on gas exploration starting on Page 90 of this issue.

These are nuggets—not just pennies—from AAPG members who know what it takes to find gas. And they stress the probability that gas reserves will be insufficient to meet demands in a few years unless there is more incentive to hunt for gas specifically.

Somebody should get the word to Kennedy, Landis & Co. that in revising the FPC they should pay more attention to that practical probability than to theories of mathematical probability in wildcatting.

Dollars from consumers will find a heck of a lot more gas than pennies from Harvard.

—Henry D. Ralph

WHAT MAKES A good waterflood Packer?

Waterflood service demands a packer that's long on performance and short on cost. The picture shows one that is. It is lean and clean, short and compact. Its packoff is positive and dependable, it has great holding power, it is easy to set and retrieve. What makes all these things possible in a low cost packer? See the facts below.

BAKER

Model A Retrievable Tension Packer

To get Bulletin 334, write Baker Oil Tools, Inc., P. O. Box 2274, Terminal Annex, Los Angeles 54, Calif.

BAKER OIL TOOLS, INC. / HOUSTON / LOS ANGELES / NEW YORK

A quick look at the facts about this important retrievable pressuring tool

WHY IT WORKS SO WELL

A Baker Model A Retrievable Tension Packer is compact (and economical) because it is simple. Baker rocker type slips, for instance, have both simplicity and superior holding power – a good combination in any pressuring tool. They are one of the great advances in slip design in recent years. This packer also has a performance-proved packing element – and a full bore that permits running wire line tools or instruments.

WHERE AND HOW TO USE IT

1 It gets its main play in waterflooding.

2 It's also a squeeze packer for simple pressuring operations where you don't need the supervision of a Baker tool specialist. For instance: when fracturing in shallow or low-fluid-level wells.

3 There are times when you may want to leave a packer in the well after a pressuring operation. The low cost of a Baker Model A recommends it for such service.

4 There are also times when you may *have* to leave a packer in the well. For instance, when you've got defective casing and there's doubt you would be able to retrieve *any* packer. You can leave one of these low cost packers in the well and knock it down out of the way with little trouble or expense.

5 You can set and reset any number of times in one trip. It is rugged enough to be used many times in many wells.

6 It is simple to maintain and redress. Standard parts are available from Baker's many field service locations.

HOW TO SET AND RELEASE IT

A simple and reliable J-Slot makes this packer very easy to set and release.

1 To set packer, you rotate tubing ¼ turn to left to unjay the slips, then apply tension to pack off.

2 To release, you relax tubing tension to relax packing element and permit slips to retract, then rotate ¼ turn to right to lock them in retracted position. Now you can retrieve.

3 There are two safety release systems.

Intellectual bankruptcy in meeting the gas problem

PRESIDENT KENNEDY'S proposal to exempt small gas producers from price regulation is an ill-considered desperation move.

It is so far from a solution to the gas-price mess that it resembles a drowning man's grasping for a straw—and will be just as ineffective.

Faced with a monumental dilemma, the administration is ignoring the basic issue and is simply nibbling around the fringes. Where are the bold new approaches to governmental problems that were promised by the New Frontier?

THE PLAN IS WRONG in principle, inconsistent, and inequitable. It could create as many administrative problems as it purports to eliminate. It will spawn fundamental changes in the structure of the gas-producing business. It could diminish rather than increase gas reserves. And it won't keep consumers' prices from rising in response to market forces.

The basic problem is how to regulate field prices. The individual cost-of-service method hasn't worked, so continuing to apply that to some producers and no regulation to others won't solve the problem. Making sales volume the definition of a public utility is dodging the issue.

Ignorance of the nature of the gas-producing business is evident in the proposal. Among other results of this economic tinkering, interstate sales would rapidly shift from a few big producers to thousands of tiny operators exempt from regulation, thus defeating the plan's purpose.

There's a small bright spot, however. The proposal is, in effect, an admission that the cost-of-service idol has feet of clay, that the utility formula is not a perfect, universally applicable panacea.

Like FPC's area-pricing approach, it embraces the concept that if there is a check on a portion of the gas supply, the rest may be left to the forces of a free market.

Having reached this point in its analysis of the problem, the administration should have continued its line of thinking and gone on to a more logical and far-reaching conclusion.

THE EXEMPTION NEEDED is to exempt FPC from adherence to the utility cost-of-service formula and from the vague and ambiguous court decisions which have frustrated its every attempt at any method of regulation.

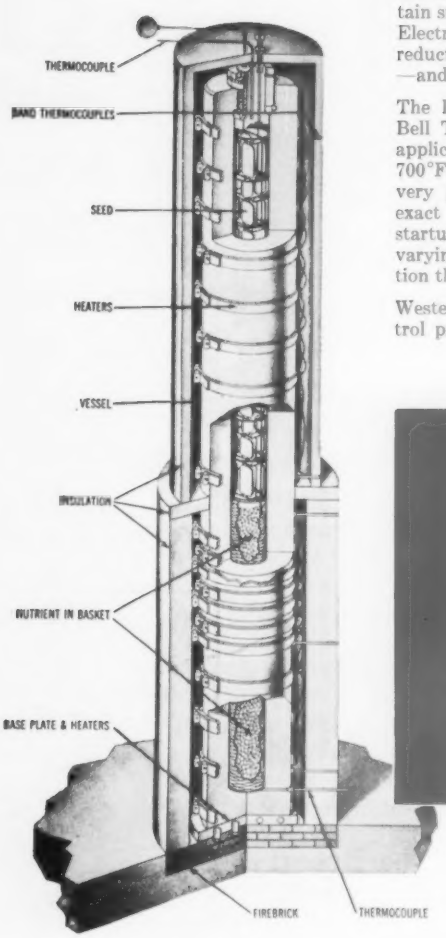
The only real solution to the court-made chaos in gas pricing is congressional enactment of entirely new rules. FPC should be given broad authority to protect the general public interest by maintaining adequate supplies of gas at fair prices.

It is tragic that the industry has no alternative to offer at this point. Now that the President has opened the heretofore taboo subject of gas legislation, the industry should have a draft of a bill ready.

The whole gas industry, no less than the administration, is exhibiting intellectual bankruptcy by its failure to advance a solution to this problem.

Western Electric's Fabulous Quartz Crystal "Factory"...

UNDER FULLY AUTOMATIC *Taylor* ELECTRONIC CONTROL



The Western Electric Company, at their Merrimack Valley works, North Andover, Mass. is the world's first quantity producer of artificially "grown" quartz crystals. Developed to meet the fast growing needs of the Bell System, and to offset the uncertain supply of natural quartz, the Western Electric process produces crystals at a reduction in the cost of the natural variety —and with fewer imperfections.

The hydrothermal process developed by Bell Telephone Laboratories requires the application of about 25,000 psi pressure at 700°F. within an autoclave. It demands very precise control of temperature and exact temperature differentials during startup. Also extremely accurate and unvarying temperatures and pressure regulation throughout a 21 day "growing" period.

Western Electric engineers set up the control parameters, time program and tolerances necessary; Taylor Instrument Companies designed the electronic control system—completely automatic aside from loading and unloading. Safety instrumentation, also provided by Taylor, is so reliable that the entire crystal growing building is left unattended except during the day shift.

TRANSCOPE* electronic instruments met two major requirements for this application. Uninterrupted control is assured by the use of premium quality components. Overpeaking at the beginning of the growing period is eliminated by the unique design features of the controller which includes a diode limiter circuit. We are proud to have played a part in this outstanding achievement of Western Electric Company.

Taylor Instrument Companies, Rochester, N.Y., and Toronto, Ontario.

*Reg. U.S. Pat. Off.

Taylor Instruments

Coals to Newcastle — Western Electric, manufacturing unit of the Bell Telephone System, chose Taylor Electronic Controls for this critical process. Central control panel (above) shows two sets of "warm-up period" recorder-controllers in center (vertical rows of three each), and ten pairs of "growth period" recorder-controllers on either side. Beneath each pair is a digital counter showing duration of growth period in 10ths of days.

Right — Seed plates being lowered into the autoclave for the 21 days growth.

Left — A harvest of sparkling crystals . . . with none of the imperfections usually found in natural quartz.

Far Left — Cross section of one of 20 autoclaves. Process depends on the maintenance of a critical temperature differential between the nutrient area (lower zone) and the seed plate area (upper zone). Nutrient—low grade quartz—dissolves in hotter lower zone and is carried by convection to the cooler, upper seed chamber where it deposits onto seed plates in a single crystal form.

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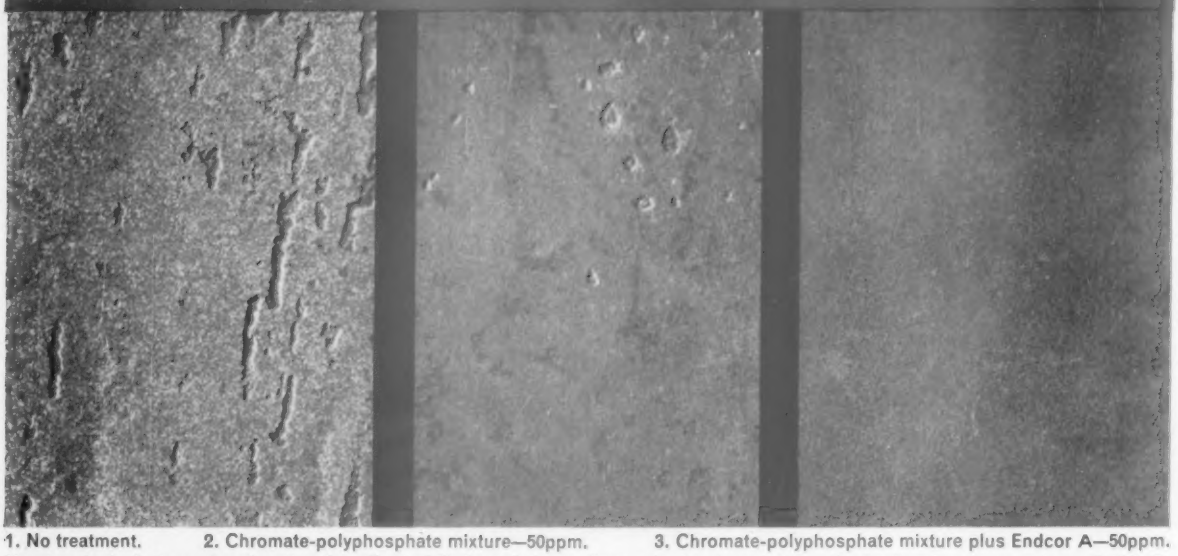

1. No treatment. 2. Chromate-polyphosphate mixture—50ppm. 3. Chromate-polyphosphate mixture plus Endcor A—50ppm.
Unretouched photographs showing the effect of Endcor A in cooling water treatment at a pH of 6.5 and a temperature of 130° F.

Today, there's more than two years of performance proof behind Dearborn's cooling water treatments with the research developed additive, Endcor.

And today, more and more companies, with millions of dollars worth of cooling systems and equipment to protect, are striking out the "or equal" clause and directly specifying one of these Endcor products.

There's Polychrome ® 501 and 505 with Endcor A . . . Dearborn ® 860 with Endcor B . . . and others —all designed to do specific corrosion and deposit inhibiting jobs more precisely, more effectively, and, in many cases, more economically.

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There'll Be No Rush to Pass a Gas Bill

• Kennedy's proposal to revamp the Natural Gas Act will bring hearings—on it and other ideas. But without a written bill—from Kennedy or industry—Congress will move slowly. Gas is a live subject again, but without urgency.

PRESIDENT Kennedy may have succeeded in prying the lid off the gas-legislation issue.

Until he made his proposal to Congress that small producers be exempt from direct control, there appeared little likelihood that Congress would take up any gas legislation this year.

Now the picture has changed. Congressional hearings will probably be held before the current session recesses. If so, counter proposals will be considered as well as the Administration's plan.

This could mean, then, that a wide range of suggestions will be hashed over.

The outcome is anybody's guess. But the odds appear heavy against adoption of the exemption plan advocated by the President in his message to Congress on regulatory agencies (OGJ, Apr. 17, p. 81).

Despite apparent coolness to Kennedy's suggestion, however, it is not likely that it will be ignored completely.

One big reason is that even the opponents of the exemption plan are aware that if the President's proposal is pigeon-holed, the Federal Power Commission itself may adopt the plan on its own.

By mid-year, the President will have appointed a majority of the five-man commission. This majority could abandon the present commission's area-pricing approach and substitute the small producer exemption plan.

There are those, including James M. Landis, the President's chief adviser on regulatory matters, who feel that the FPC could legally institute such a policy without waiting for congressional action. The only reason legislation is being sought, therefore, is to avoid a court test of an FPC administrative action.

So, knowing that lack of action on the President's recommendation may not be enough to block the plan, opponents are faced with the problem of developing positive legislation to offset it.

The outlook . . . Congress will probably move slowly in considering the exemption plan and other proposals. Many congressmen aren't at all eager to see an all-out fight over a gas bill develop.

Several congressmen, including those who have been involved in gas legislative matters in past years, were privately dismayed when the President sent his regulatory message to Capitol Hill.

For example, Rep. Oren Harris (D.-Ark.) is extremely unhappy. And Harris is chairman of the House Interstate and Foreign Commerce Committee through which a gas bill will pass.

Harris doesn't like the idea of treating one producer in one manner and another producer in another manner. Furthermore, he doesn't think the exemption plan will work. It may sound simple, but Harris fears that application wouldn't be simple at all. Instead, it would bog down in legal technicalities.

Harris told The Oil and Gas Journal last week that no hearings have been scheduled by his committee. For one thing, he pointed out, no specific gas bill has been sent up from the White House for Congress to consider. All Congress has to go on at this point are the general recommendations contained in the President's message.

Also, Harris is reluctant to see the gas issue raised at this time and in this manner. He had hoped that the various segments of the industry could agree on a bill—perhaps one similar to legislation Harris has proposed in the past—that could gain widespread support.

He conceded, however, that his committee will probably hold hearings on the President's proposal. If so, he is going to make certain that other proposals are also considered.

Frank Ikard (D.-Tex.) is also highly skeptical of the feasibility of the President's plan. He doubts that it carries much appeal even for the small producers it would exempt. And he fears that Kennedy's proposal will draw support away from other legislation which Ikard feels would be much more satisfactory.

Some other members of the committee, particularly those from producer states, have voiced similar views privately.

On the other hand, some members of the committee will push for the President's proposal. This group includes Rep. Torbert Macdonald (D.-Mass.), who has already introduced exemption legislation, and Rep. John Dingell (D.-Mich.) and Rep. John Moss (D.-Calif.).

On the Senate side, Sen. Warren Magnuson (D.-Wash.), chairman of the Senate Interstate and Foreign Commerce Committee, had indicated earlier that he would submit to his committee any gas proposals made by the President.

There was no indication last week when Magnuson would seek committee hearings.

Many congressmen are going to

play a cautious, waiting game. They want to size up general reaction and to weigh other possibilities before committing themselves.

Industry views . . . The industry, too, apparently wants to look before it leaps.

Certainly at this point there seems to be little enthusiasm for the President's proposal. But there is no sign that the President's action has stirred the industry into consolidating its forces behind some other approach.

Thus the chief weakness of the industry position now seems to be that it has nothing specific to offer as an alternative to what Kennedy has suggested.

It is likely that producers will lead the opposition to the exemption plan. But they may get little active support from pipeline or distributor groups.

On the brighter side, there is little indication now that an intra-industry fight will develop similar to the bitter battle that occurred when gas legislation was last under active consideration by Congress.

Here's Why Industry Wants No

THERE'S no enthusiasm among gas men for President Kennedy's proposed changes in the gas law. Here are the reasons given the Journal by producers of all sizes:

PRINCIPLE—It's un-American not to apply the law equally to all, regardless of size. It is discriminatory to rule that volume of sales determines whether or not a producer is a utility. No independent producer should be regulated as a public utility, and the industry should stand together on this principle.

APPROACH—Exemption of 10% of the gas does not solve the basic problem: How to determine a fair and reasonable price for gas in the field.

FPC would still have to deal with 270 companies producing 90% of the gas. It would have the same old problem of trying to find a cost-of-service rate base for them. In 7 years FPC has done this for only one producer (Phillips) and this decision is tied up in the courts. So while FPC's docket might be shorter, its real work load would be just as great.

An approach is needed to get away from the utility concept and treat gas as a commodity.

POLITICS—The proposal is a political move to divide and conquer the producing industry. It is an attempt to silence hundreds of small producers with wide political power, thus making it less likely that remedial legislation will ever be enacted.

ADMINISTRATION—FPC would have a huge and continuing problem policing the exemptions. All producers would have to file annual statements to qualify for exemption.

As a company's interstate sales grow or shrink it would be regulated

. . . And What A Number of Industry Leaders

Paul Schultz, President
Blackwell Oil & Gas Co.

As a little gas producer, I would like to be decontrolled. But I figure we are in the same boat with the majors. After all, we all hope to get big sometime.

For those of us near the point of being controlled, the President's proposal could force us to do a lot of things not considered good business. As we grow, it could force us to sell off our reserves or to divide the company into separate units. In short, such regulation would force people to maneuver their operations to avoid controls. This would require more complex regulation—with more people constantly checking to make sure there is no evasion.

The job of getting adequate gas reserves is split between the small and large operators. Federal control has and will continue to offset the producer's individual ability to get adequate supplies of gas.

So long as any part of the industry is under control, it will impair our ability to meet the gas demands of this nation's consumers.

Gas, from an energy-content standpoint, is so cheap anyhow that federal control is ridiculous.

E. Clyde McGraw, President
Transcontinental Gas Pipeline Co.

Exemption of the small producer doesn't make a great deal of difference. Anything to relieve the bottleneck is a step in the right direction. Certainly the President is right when he says these small producers don't dictate the price of gas. Large producers don't either. The good old law of supply and demand still determines the price we can afford to pay for gas regardless of regulatory rules.

Robert L. Kidd, Chairman
J. E. Heston, president
Cities Service Petroleum Co.

The President's proposal to Congress to exempt small producers of natural gas from regulation, while indicating a proper awareness of the intolerable problems attending present regulation of gas producers, is unfair in principle and would be difficult to administer.

Discrimination between producers on a basis of size is inequitable; all should be treated alike.

Under the President's proposal, the growth of the

Part of Kennedy's Proposal

one year and exempt the next, and neither FPC nor gas purchasers could predict future prices of such "borderline" producers.

Before long there would be pressure to reduce the size of the exemption, or to remove it.

FPC would have to examine thousands of exempt producers to see whether they are bonafide or simply dummy companies set up by a big producer to escape regulation.

PRICE—Some small producers think it would be impossible to get higher prices than those allowed to regulated producers, so in effect they would be regulated by a competitor's operations rather than their own.

Most producers, however, predict that within a short time exempt producers would get much higher prices than regulated producers.

Small producers' escallation or redetermination clauses would take effect as scheduled on being freed from regulation. Regulated companies could not make their contract prices effective without long proceedings. This advantage of the smalls would increase with time.

Exempt producers could accept a pipeline offer and start deliveries at once, whereas regulated producers would have their contracts price-conditioned and might never collect the full amount.

ECONOMIC EFFECTS—Most gas would soon be produced by thousands of very small companies. Exempt operators would not dare grow big enough to lose their exemption, and groups of smalls would not pool their capital and resources to undertake new ventures. This could cut down exploration for new reserves.

Medium-sized producers would break up into several small companies in order to escape regulation.

Large producers would farm out all gas drilling and producing to small operators who would promise to remain exempt. The majors would assemble lease blocks, do the geology, and then farm out leases while retaining an override. They would set up and often finance independents to handle such farmed-out production in order to escape regulation.

TWO-PRICE SYSTEM—The proposal perpetuates what FPC has criticized as ridiculous and unworkable—two or more prices for gas from the same well. Many exempt producers would have joint interests in wells or units operated by regulated producers, so part of the gas in a common stream would take the regulated price and part the unregulated price.

By reason of this, exempt producers would have a tremendous advantage over the regulated in obtaining leases for new drilling, since landowners would lease only to operators in position to pay higher royalties.

Have to Say About It

Kidd

Heston

small producer would almost certainly be inhibited. In effect, he would be told to "stay small." Moreover, he would be handicapped if he tried to sell his properties and, from a price standpoint, could expect no substantial benefits.

Segregation by size of producers would also produce such absurdities as regulation of some owners of a multiple-interest well while exempting others.

While on its face the proposal would reduce the backlog of cases before the Federal Power Commission, it does nothing to solve the basic problem: How to decide what gas prices "should be." The process of decision-making is untouched.

Estill S. Heyser, Jr., President
Texas Mid-Continent Oil and Gas Association

President Kennedy's suggestions for reorganizing the Federal Power Commission do not appear to offer any real help to the natural-gas consumer or the gas producers.

No matter how many commissioners are assigned, they will not be able to regulate producers effectively under the present Natural Gas Act, which is not designed for producer regulation as a utility. The basic law needs changing first.

The proposal to exempt all the producers who sell less than 2 billion cubic feet of gas a year is, in itself, an admission that the law cannot be applied to the production of natural gas.

This approach creates suspicion, because it has long been advocated by certain individuals who have been foremost critics of depletion allowances and independent oil men generally.

The consumer's need is served by large supplies of gas, but this proposal places a premium on tiny fields with small outputs. It is comparable to putting auto manufacturers back into thousands of blacksmith shops.

It also seems that several small producers who, individually, were under the ceiling would be prevented from pooling their capital to embark on larger gas exploration and development programs if their total

production exceeded 2 billion cubic feet a year.

Once a producer outgrew the ceiling, the tendency would be to sell as much gas as possible in the intrastate markets, which are not under regulation. This would work against the consumer interest.

G. Scott Hammonds
Independent producer, Dallas

The legislation to free producers of less than 2 billion cubic feet of gas per year was introduced and is being supported by some individuals who have previously attempted to reduce depletion and opposed bills to free the independent producer from FPC regulation.

It is discriminatory, will serve only to divide and conquer the industry, and would pose many questions of administration.

A few large companies with no political force would be regulated and their prices depressed. In turn, the pipelines would not pay more for the 10% unregulated than the 90% regulated, so those freed from regulation would, also, receive depressed prices.

Further, after dividing the industry, either through Supreme Court action or legislation to reduce or repeal the exemption, the small producer would be again regulated.

Support of this proposal by the independent producer would be deserting an ally, the royalty owners; for the gas owned by 90% of the royalty owners would still be under regulation.

O. Wayne Crisman,
General manager, production division
Delhi-Taylor Oil Corp.

At first blush, the proposal of President Kennedy to exempt "small" producers from regulation appears to be a laudable approach to a knotty problem. However, there still remains a doubt in the minds of many producers about the jurisdiction of the Federal Power Commission under the present Natural Gas Act.

Furthermore, the attempts by the FPC to bring under regulation producers of natural gas have proven to be unworkable as evidenced by this attempt to exempt operators who produce less than 5.5 million cubic feet of gas daily. Purportedly, 90% of the producers will be exempt from the dictates of the commission.

It would appear that the suggested decontrol is not at all equitable, since, if the "small" producer gets the same price at the wellhead for his product that the large producer does, everyone should be exempt from regulation.

What is really needed is a fair and equitable law which will encourage the exploration for and development of natural gas, and exempt all producers of natural gas from regulation.

Orville S. Carpenter, President
Texas Eastern Transmission Corp.

President Kennedy's proposal to place in escrow funds collected by natural-gas companies subject to refund is completely unworkable and defeats the purpose of the collection provision as it has appeared in the Natural Gas Act from the beginning.

Statements have appeared in the press to the effect that these collections afford an interest-free source of capital to natural-gas companies and that filings are deliberately overstated in order to obtain interest-free capital. These statements are absurd.

The FPC has always required interest to be paid on collections ordered to be refunded. Such interest was paid at a rate of 6% until April 1, 1960, when the FPC increased the rate to 7%, despite the fact that no rate of return as high as 7% has ever been approved for pipeline companies by the FPC.

The proposal to increase the commission from five members to seven will not accomplish the intended purpose and may very well result only in additional delays because of an additional number of persons involved in the decision-making process.

F. Allan Calvert, Jr., Chairman
Natural Gas Committee, Independent Petroleum Association of America

The concept of centralized control over local production of natural gas by the federal Government has been on trial for 7 years. The effort to regulate the production of gas has been an exercise in futility. It has cost government, industry, and consumers of gas a staggering toll in time, money, and manpower.

President Kennedy's proposals are encouraging. The President has recognized that, in concept and in practice, federal regulation of the gas producer has been a failure. His recommendations also recognize that practical changes have to be made, through the legislative process.

Differences exist as to the specific proposals of the President. The one of most direct concern to producers is the recommendation that producers of less than 2 billion cubic feet of gas per year be exempt from controls. Obviously, this would discriminate between producers on the basis of size, alone. Such treatment would tend to penalize success, and, in America, success is the very thing we are trying to encourage.

The entire function of the production and gathering of natural gas in the field is the same, as a matter of principle, irrespective of the size of producers.

Under the President's proposal, the small producer thus would remain under indirect regulation without right or opportunity to plead his case.

Gulf Shows Fast Drilling's No Fluke

• Smashing its own records, Gulf drills 9,500 ft. in 48 hours in an offshore well in South Louisiana. The staggering performance has silenced critics who said other Gulf drilling triumphs were freak achievements.

A LOT of skepticism died in South Louisiana last week. Gulf Oil Corp. killed it intentionally.

The skeptics had been saying Gulf's recent fast-drilling records were flukes without lasting significance.

Gulf has laid that belief to rest permanently with a performance that leaves even the strongest believers gasping.

A Gulf well spudded last Tuesday at 8:15 a.m. had reached 7,518 ft. by the same time Wednesday. By 8:15 Thursday, the hole was at 9,500 ft.

That's the fastest 9,500 ft. ever drilled in a 48-hour period. Included was one bit run of 6,107 ft. in 14 hours.

All these figures make former records look like a snail's pace.

It's hard to predict what Gulf might do next. Five times in the last 15 months, there have been reports of what was considered a crowning success by Gulf in the waters off South Louisiana. And after each report, Gulf has put on a burst of speed surpassing anything seen before.

First it was 10,000 ft. in only 5 days. Next it was 10,000 ft. in 4 days, 17 hours. By last July the company hit a mile-a-day pace, drilling 5,412 ft. in one 24-hour period.

Several times recently, the company has reached 10,000 ft. in less than 4 days. Best time until last week was 3.4 days.

There had been some doubt in the drilling industry about just what such speed actually signified. With each performance, fewer doubters remained to wonder aloud, "What does it mean if you can't do it again regularly?"

If there were any skeptics left this week, they weren't announcing themselves. Everyone seems to be satisfied that Gulf can indeed do it again regularly.

The rig and crews which set last week's almost unbelievable marks are those of Kerr-McGee Oil Industries. Kermac had contract for the well, Gulf's No. 25, Block 21, offshore Timbalier Bay field, and put its giant fixed-deck submersible barge, Rig 47, on the hole.

While Rig 47 is unquestionably one of the finest drill barges at work today, and while its crews have won distinction for themselves, the final acclaim belongs to Gulf. Gulf men conceived the fast-drilling methods and Gulf men were on hand to oversee their use.

No snowbank . . . It has been tempting to discount the ever-increasing speeds on grounds that "the formations are no harder to drill than a snowbank."

Gulf's men don't deny the formations they've been drilling are soft. But they point out that any formation which takes 60,000 to 80,000 lb. weight on bit is no snowbank. And Gulf has been using that much weight often on the 12¼ and 9⅞-in. bits.

Also, while Gulf's men are too charitable to say so, the doubters have the same opportunity Gulf has—they drill the same areas. But to date few have approached the Gulf records.

The company's formula for faster drilling isn't easily summed up.

It begins with borrowing the bit weights and drill collars from hard-rock drilling. Last week's string included twenty 7-in. and four 7¾-in. drill collars.

Too, Gulf throws in some of the best hydraulics that can be imagined. Jet velocities range up to 450 ft. per second and sea water is circulated at rates as high as a 1,000-hp. pump is capable of delivering through 5-in. drill pipe.

In spite of the high circulating rates, drilling speed is so great that the water which goes in weighing only about 8 lb. per gal. often comes back weighing more than 10.

Hours are saved by speeding connection time. Where many rigs require up to 5 minutes to make a connection, the Kermac crews last week took less than 1½ minutes.

In the first 24 hours of their record run, Rig 47's two crews made a staggering total of 250 such connections.

Big time, big money . . . Drilling men have always been fond of the old law about time being money. So they can understand that Gulf has done more than set up a new relation between time and depth. The company has made a big cut in the cost of its wells.

General consensus is that the fast drilling has reduced Gulf's offshore drilling cost to a point near its onshore costs.

Texas Well Fractured by 8,000 Hp.

A RECORD 8,000 hp. has been used to fracture a Gulf Coast well.

Shell Oil Co. is attempting in the well to pinpoint fractures to the more porous sections in a 500-ft. interval.

Halliburton Co. used 15 fracturing units to pump 80,000 lb. of sand and 60,000 gal. of water to an average depth of 10,100 ft. The company says it believes the 8,000 hp. is the greatest ever used on a hydraulic fracturing job.

The work was done on the Plow Realty Co. No. 40 well in Sheridan field, Colorado County, Texas.

Halliburton says the large horsepower made it possible to pump the 60,000 gal. into the well in 40 minutes.

Texas Clamps 8-Day May Allowable on Crude

TEXAS WILL choke back crude production sharply in May.

Climbing crude storage led the Texas Railroad Commission last week to set the May flow pattern at 8 days.

The initial allowable for May will be 2,636,562 bbl. daily — down 185,459 bbl. daily from the initial allowable for April and 223,974 bbl. daily below the allowable in effect April 8.

The commission action was in line with the wishes of a majority of crude purchasers.

Nine companies—Indiana Oil Purchasing, Texaco, Sinclair, Shell, Cities Service, Conoco, Standard of Texas, Humble, and Gulf—recommended 8 days for May.

Only three—Mobil, Sun, and Atlantic—asked for 9. Phillips Petroleum sought only 7 days.

Switch by Humble . . . Humble, which has plugged hard for higher Texas allowables for many months, took a different tack this time.

A spokesman said the company would purchase only minor quantities of spot crude on 8 days, while it would have 30,000 bbl. for sale on 9 days.

Reason given for pulling in its horns: Reduced runs and climbing crude stocks.

The company's crude stocks as of March 1 were more than 2,500,000 bbl. below its desired level, testimony showed. But by April 1, stocks were only 400,000 bbl. below—and the deficit will be entirely wiped out by May 1.

Phillips, in recommending only 7 days, said it would like to reduce its crude inventory.

An official said the company would like to sell 15,000 bbl. daily even if 7 days were adopted. On 8 days, the company will have 20,000 bbl. daily for sale.

Independents' views . . . Independent testimony, with one exception, also heavily favored an 8-day allowable.

Wesley West, Houston independent, told the commission it ought to adopt a 30-day pattern and let the chips fall where they may.

Oil operations, he said, are booming in other states but crumbling in Texas.

West said he didn't think the commission was acting in the best interests of the state when it reduced allowables so heavily.

West's view was quickly challenged by other independents.

George Anderson, vice president of the North Texas Oil and Gas Association, said North Texas producers would love to see a 30-day allowable if possible.

"But this isn't possible. And we aren't in any position to participate in this kind of experiment," he said.

Crude Runs Whittled at Last

. . . by Texas refiners. Cutback in March was made in acknowledgment of climb in product inventories.

REFINERS of Texas crude dropped still runs to an average 6,123,967 bbl. daily in March in a belated response to fast-mounting product inventories.

At this level, runs were averaging 232,790 bbl. daily under the January processing rate of the same companies.

Comparable figures for February are not available.

Runs for that month were given the Texas Railroad Commission during its annual March probe for statistical data. But some replying companies were not purchasers of Texas crude. And some that normally file such figures did not do so.

However, the Journal's index of runs by 13 major refiners processing Texas crude does provide some gage. Runs by these companies were at a peak in February of 5,576,807 bbl. daily. They fell sharply last month to average 5,283,674 bbl. daily—a drop of 293,133 bbl. daily.

Most of the drop came in these heavy-runs cuts: Humble, from 875,000 bbl. daily in February to 786,000 bbl. daily in March; Standard Oil Co. (Ind.), from 698,000 to 601,000 bbl. daily; and Shell Oil, from 533,000 to 485,000 bbl. daily.

Only two of the 13 major firms increased runs in March. Phillips was up about 2,000 bbl. daily, and Sun hiked its runs about 19,000 bbl. daily.

Drop in total stocks . . . Total storage of crude and products was reported by some 35 purchasers of

A Look at March Crude Runs to Stills

Company—	Avg. in bbl. daily	% of capacity
Am. Petrofina	21,991	73.3
Atlantic Ref.	187,596	89.3
Bell	6,537	81.7
Bryson Pipe Line	411	40.0
Cities Service	247,618	84.5
Continental	183,690	95.0
Cosden	36,083	83.9
Crown Central	34,552	86.4
Danaho Refining	4,197	...
El Paso Natural	19,974	90.8
Gulf	462,610	82.1
Humble	786,000	81.7
Indiana Oil	601,000	83.4
LaGloria	16,538	68.9
Monarch	2,943	73.0
Ohio	98,924	89.5
Permian	3,476	86.9
Phillips	223,700	81.6
Plymouth	35,377	78.6
Premier	16,866	75.0
Pure	174,953	93.5
Rado Refining	823	55.0
Shamrock	23,355	86.5
Shell	484,928	81.6
Signal	52,613	87.7
Sinclair	406,598	83.2
Skelly	51,308	94.0
Socony Mobil	585,000	81.6
Sohio	141,562	83.0
Standard (Tex.)	52,253	69.7
Sun	220,521	86.5
Suntide	40,791	63.0
Texaco	646,478	87.5
Tidewater	247,935	90.2
Wickett	1,791	51.0
Others	2,975	
Total	6,123,967	

Texas crude at 472,252,700 bbl. on April 1.

This is a drop of 5,214,000 bbl. from the total on hand February 1. Here again comparable figures for March aren't available.

The drain on total stocks was due to a heavy run on distillate and was registered despite a buildup in inventories of both crude and gasoline.

Still too much . . . Despite the cut in total storage, there's still too much crude and products in the tanks, the companies told the commission.

At current levels, total storage is 17,885,300 bbl. too high for this time of year.

The companies gave the commission individual figures on actual and desired levels which give this composite picture:

Crude storage is 1,996,100 bbl. too high.

There are surpluses of 2,405,600 bbl. in gasoline, 4,229,200 bbl. in kerosine, and 9,327,100 bbl. in distillate.

Only resid is deficient, running a paltry 72,700 bbl. below the composite desired level.

Lufkin Making Mark II's

A STREAMLINED version of the Mark II unit pumper is being produced by Lufkin Foundry & Machine Co.

Delivery is already being made on some models of the unit, which is marketed as the Lufkin Mark II Unitorque.

Most standard API sizes, between 80,000 and 912,000 in.-lb., are being assembled in the manufacturer's Lufkin, Tex., plant.

The Mark II was designed and previously manufactured by Oilfield Equipment Corp., Denver (OGJ, Dec. 12, 1960, p. 105). Lufkin now holds exclusive world-wide rights.

These changes have been made:

Structure has been beefed up, a cast-iron crank has replaced a fabricated steel crank, and gear reduction has replaced chain-drive transmission.

Some features of the original OEC design have been kept. These include a semiautomatic counterbalance mechanism.

watching WASHINGTON

Clyde La Motte

• A rash of oil developments in Washington now . . .

IT IS HARD to recall when, aside from wartime, more things affecting the oil industry were popping in Washington.

Take a look: Crude-oil-import hearings are just ahead; the President has asked Congress to exempt small gas producers; the military is testing the barter plan, and the Export-Import bank is processing applications under its new policy of credit backing on sales of oil equipment abroad.

Also, the Federal Power Commission is holding another meeting on area pricing and the Office of Civil and Defense Mobilization is getting involved in the residual-fuel-oil-import situation.

On Capitol Hill, Congress is nearing showdowns on a fuels study, on minimum wages, and on taxes for the highway program.

• This new administration can move fast at times . . .

THE TWO "sleepers" thus far this year were the administration's quick switch in past government policy concerning credit support for oil-equipment sales abroad, and the push to barter surplus agricultural products for foreign oil. Not many observers had anticipated either action, at least not so early in the life of the new administration.

The equipment-sales move offers interesting possibilities, particularly if the new policy is broadened to cover financing for entire projects.

It would seem entirely feasible to anticipate that the new policy could stimulate small and medium-size oil ventures in numerous countries interested in building refineries or in stepping up their own drilling activities. There is no question that some have been hoping to undertake such projects but haven't had financing available.

Some major companies aren't very happy over the new policy, especially since it extends to nations with an oil monopoly. The way they figure it, Uncle Sam is now in the position of backing help to government monopolies in direct contrast to this nation's long-standing advocacy of private enterprise.

The military's barter project has two aspects which cause some oil observers to raise skeptical eyebrows.

One objection is that it involves a company unnecessarily in more red tape on its sales to the military. Companies will have to get together with brokers to work out plans for disposing of the grain they will get in exchange for the oil they sell when the barter plan is involved.

Another objection is that the new U. S. move into bartering will encourage other countries where major oil companies do business to insist, in turn, on bartering when a company sells oil there.

• Kennedy has jumped into gas-regulation picture . . .

MEANWHILE, back at home, there looms the threat of the "exempt" approach to natural-gas regulation. Few in the industry like it.

The idea has been kicking around for years without making headway, but it may make some now that the administration is backing this approach.

If it does gain momentum, the industry can blame itself for not coming up with a better proposal earlier. In effect, lack of action helped create a vacuum and the President's proposal is now moving into that vacuum. Once again, the industry will be on the defensive.

1 Automatic welding machine developed by H. C. Price Co. encircles the pipe on the firing line.

2 Welding unit is on top of the pipe and ready to start the weld down the side.

3 Moving down from the top of the pipe, the unit welds the upper quarter.

4 Operator watches welding through a look-box as the new device continues on its path around the pipe.

New Machine Position Welds Automatically on the Line

MECHANIZATION of pipeline welding on the right-of-way is coming fast.

A new type CO_2 machine developed by H. C. Price Co. can automatically weld big-inch pipe in a fixed position.

In a field test 36-in., 0.438-in. wall, X-52 pipe was welded without rotating it. This is the first time such welding has been done on big pipe in the field.

Tests were conducted near Burney, Calif., on a section of the Alberta-California gas pipeline system which is being constructed by Price for Pacific Gas & Electric Co. Four welds were made on the line April 12. They were inspected by X-ray.

An oscillating arc is a special feature of this new CO_2 unit developed by the Price company in collaboration with Crose - Perrault Equipment Corp. and with assistance from Hobart Brothers Co. on wire electrode machine and technical welding advice.

The Price technique directly attacks the problem of applying mechanized welding under today's conditions on the right-of-way. It utilizes available clamp equipment and is adapted to pipe ends shaped for the familiar joint design with 30° bevel, $\frac{1}{16}$-in. land and $\frac{1}{16}$-in. spacing. Stringer and hot-pass beads are now run manually. But the company plans for the pipe gang to use automatic welding eventually.

Rapid oscillation of the arc applying weld metal fills and caps the wide 60° V-shaped groove. Under the protection of a stream of CO_2 gas, 2½ beads are run with a fine wire electrode.

In contrast, the Esso-Airco CO_2 method calls for precise lineup to facilitate the making of a complete weld in a narrow slit about $\frac{1}{16}$-in. wide. Welding of 6-in., 0.219-in. wall, X-46 pipe by this technique was field tested in January by Humble Pipe Line Co. at Odessa, Tex. (OGJ, April 10, 1961, p. 122).

Harold C. Price, president of H. C. Price Co., hopes to develop a fundamental electric-arc automatic pipe-welding machine.

OCDM Reports New England Resid Prices Up

• Some congressmen from northeastern states act alarmed over upswing of prices in second half of 1960. But they ignore another point made in the report: Prices in first quarter of last year were lowest in a long time.

A RISE in residual fuel oil prices in New England during the last half of 1960 has given industrial users and some congressmen from that area an opportunity to "point with alarm."

The current flurry stems from a report on resid prices by the Office of Civil and Defense Mobilization.

It shows that prices on tanker deliveries for resale in New England rose from $2.02 a barrel in January 1960 to $2.25 a barrel in December. Most of the increase occurred after mid-year.

The report notes, however, that prices were lower in the first quarter of 1960 than in any other quarter of the 4-year period covered by the OCDM study.

In New England specifically, the average price during the first quarter of last year was 5 cents a barrel under the price in the last quarter before import controls began.

OCDM said that during the first 15 months of the control program, prices were either unchanged or were actually lower than in earlier, pre-control periods.

This trend apparently continued until mid-1960, when prices began moving up gradually.

Prices and politics . . . The periods of low prices naturally drew no comment from New England congressmen. It was the 1960 rise that caused them to speak up.

Rep. Hastings Keith (D.-Mass.) termed the price increases during the last half of 1960 "an alarming jump." And he said the summer increases came at a time when the market is traditionally weak.

He said he doubts New England industries have the ability "to withstand another summer of prices comparable to those in 1960."

Keith used the OCDM report as a springboard for a suggestion that the agency make a comparison of domestic residual fuel prices with those of the world market.

The implication was that New England industrialists may be charged a higher price than resid users in other parts of the world.

Keith also urged the OCDM to make a full-scale study of the resid-control program to determine whether import restrictions are essential to national security.

He reminded OCDM that it has formal petitions for such a hearing from Atlantic Refining Co., the New England Council and from Keith himself.

The outlook . . . OCDM has not acted on petitions for a residual fuel hearing on import controls. However, it is known that this is being given strong consideration.

As for the price reports, OCDM plans eventually to make them on a monthly basis. The current report is the first since a price study was launched last fall.

Because monthly price reports have been required on cargo sales since January, OCDM will have data available for monthly reports of its own.

INDUSTRY BRIEFS . . .

Sale of the 18,000-acre Whitlash oil and gas field in northern Montana to Shell Oil has netted Western Natural Gas $850,000. The field, 268 miles northwest of Billings, has 31 oil wells and 25 gas wells. Shell estimates daily production at 300 bbl. of oil and 2.1 million cubic feet of gas.

A natural-gas fuel cell research program has been set up by Northern Natural Gas and Houdry Process Corp. Goal of the research at Houdry's laboratories in Linwood, Pa., will be a cell capable of producing electricity for home and factory use.

New corporate name of Geosonic Corp. has been adopted by Research Explorations, Inc., Houston. The change follows a merger with Exploration Associates, Triton Drilling, Rex Drilling, and Electronic Systems. Geosonic will have four operating divisions—geophysical exploration, rotary drilling, applied research, and electronic systems manufacturing.

Unitized operation of McComb field in southern Mississippi has begun. Sun Oil is unit operator of the 150-well field, which was discovered in 1959. Field-wide unitization was approved earlier this year. Besides a water-injection program, plans include drilling of about 25 wells to define the outer limits of the field and consolidation of tank batteries in an LACT program.

The safety record in the gas industry improved in 1960 for the thirteenth straight year. A survey by the American Gas Association shows the accident rate for the year was at an all-time low. There were only 6.24 injuries per million man-hours which caused an employe to lose one or more work days.

Lease bidding at the March 28 auction of University of Texas lands was dominated by Humble. The sale netted $1,837,000 for leases on 118 tracts. Humble was high bidder for seven lease blocks in Ward County with bonuses ranging from $26,000 to the day's top of $140,000.

Another sale of oil and gas leases may be held by the Texas School Land Board in July or August if companies show enough interest, State Land Commissioner Jerry Sadler says.

Humble Sidesteps FPC Control in Biggest

• Planned in-place gas sale would switch ownership of 6.2 trillion cubic feet from Humble to Monterey to Columbia Gas. New Monterey company would also purchase Humble's King Ranch to Houston 30-in. gas line.

THE oil industry's largest in-place gas sale between Humble and Columbia Gas is making history in more ways than one.

The deal, involving nearly a billion dollars worth of gas reserves, may open a new way of doing business for a major gas producer who wants to escape price regulation by the Federal Power Commission.

It also solves a long-standing problem for Humble, wanting to market some of its huge reserves without submitting to FPC control, and for Columbia, needing more gas to serve its expanding markets. Also affected are gas transmission companies that have been selling to Columbia. Growth of their sales may be slowed down.

The plan . . . Key to the deal is a third company.

Humble Oil & Refining Co. and Lehman Brothers, New York investment house, have formed Monterey Gas Transmission Co. as the go-between and transporter.

Monterey has signed a letter of intent to buy 6.2 trillion cubic feet of gas from Humble's reserves in Southwest Texas. Initial purchase covers 3.5 trillion cubic feet of gas with an option for another 2.7 trillion. Delivery will be extended over the next 25 years with daily take ultimately to reach 700 million cubic feet.

No price agreement was announced. But at a conservative rate of 15 cents per M.c.f. the gas involved would be worth $930 million.

United Fuel Gas Co., a subsidiary of Columbia Gas System, Inc., has also signed a letter of intent to buy this gas from Monterey delivered at Alexandria, La. There it will be taken by another Columbia subsidiary, Columbia Gulf Transmission Co., and transported into the Northeast consuming area.

Monterey will move the gas through a big-inch pipeline from Humble's King Ranch gas plant to Alexandria. It has contracted to buy Humble's new 30-in., 238-mile gas transmission line from King Ranch to Clear Lake gas plant near Houston and will extend the line another 216 miles east to Alexandria.

Some differences . . . The Humble-Columbia arrangement differs from other recent sales of in-place reserves.

Columbia actually is not buying reserves at all but simply has made a purchase contract to take a given amount of gas at a given price from a third party who also does not own the reserves.

In one type of in-place gas deals, Tennessee Gas Transmission Co. and Texas Eastern Transmission Corp. either directly or through affiliates purchased reserves outright and presumably will have full control over their production.

In another involving a third party, Transwestern Pipeline Co. acquired $27 million worth of Phillips Petroleum Co. reserves (OGJ, Mar. 13, p. 93). The third-party company, First Transportation Gas Corp., actually bought the reserves and is selling to Transwestern under a gas purchase contract. First Transportation also is controlled neither by Phillips nor Transwestern.

Some hurdles . . . The Humble-Columbia transaction must clear a

New Monterey Officers Named

PRESIDENT of the new Monterey Gas Transmission will be John R. McMillan, right, formerly executive vice president of Monterey Oil Co. The latter company was recently dissolved when Humble purchased most of its assets.

DONLIN P. MURDY, left, former Monterey Oil vice president, will be vice president and treasurer of the new firm. Directors will be McMillan, Murdy, H. W. Haight, executive vice president of Humble, and Frederick L. Ehrman, former chairman of Monterey Oil.

Gas Sale Ever

number of legal obstacles before the deal can become final.

The Securities and Exchange Commission must rule on a method of financing Monterey's operations.

The FPC must decide whether to grant a certificate of convenience and necessity to Monterey to build the line from Houston to Alexandria. It also must approve a rate for the gas delivered to Columbia.

The basic question whether FPC has jurisdiction over the sale of in-place reserves also must be settled. Because of the newness of this type of transportation, FPC has not had the issue before it.

Humble position . . . Humble has left unanswered several questions arising from the deal.

Foremost is this: Is Humble actually giving up control of a block of its gas reserves?

Humble said the "initial shareholders" of Monterey are Humble and Lehman Brothers. It added that after the appropriate government agencies grant authority for the deal, "the new pipeline company will be financed by institutional loans and a public offering of its securities."

Whether this means that Humble expects to give up control of Monterey was unanswered. Several factors would indicate that Humble will not retain control. To do so would place Humble under the Public Utility Holding Company Act of 1935, forcing the company to check important corporate moves with the SEC. It was to gain freedom from these regulations that the parent Standard of New Jersey disposed of its far-flung gas distribution and pipeline properties in 1943.

Humble's gas policy also has been to avoid deals that would put its gas under FPC price regulation, unless forced to do so by lease or other business obligations.

Instead the company has turned to unregulated intrastate markets, particularly in the Houston area, with great success.

It also has signed a contract to sell more than a trillion cubic feet to Southern California Edison Co., Los Angeles, to be moved through a Mexican pipeline. Federal jurisdiction over this direct sale also remains to be settled.

These sales efforts, however, still left Humble with vast uncommitted reserves estimated at 25.7 trillion cubic feet. The company is conceded to have the largest gas reserves in the United States, but its marketing policy has limited its daily production to second place behind Phillips Petroleum Co.

The in-place sale of gas to an interstate market apparently is considered by Humble as the best alternative even if it won't bring as high a price as that paid in many intrastate contracts. The deal will put rate regulation one step removed from Humble onto Monterey.

If FPC considers Monterey's purchase a regular in-place sale it will not question the price. However, the terms will have an important bearing because Monterey's price to United Fuel will be based on cost of service under which the field cost of gas will be fixed for the term of the contract.

Columbia position . . . By tapping Humble's gas reserves Columbia in one stroke has increased its own reserves 42%.

This makes Columbia's position secure for years and puts it in a stronger position to serve existing customers and compete for new business in its service area.

Company officials have been outspoken in their concern about future supplies and the system's reserves of 14.8 trillion cubic feet. They have made the company the most aggressive of all distribution companies in going after new gas supplies, either by purchase or drilling.

The Humble deal has another benefit for Columbia besides adding to supply. The gas will be acquired at a relatively firm price over a long term thus tending to level off the upward trend of natural gas prices.

The transaction, however, was a double blow to present pipeline suppliers of Columbia. It will greatly increase the proportion of gas deliveries coming from Columbia's own purchases and limit the growth of sales expected by the suppliers. Columbia through the deal also captured a block of reserves that many of its pipeline suppliers had wanted for themselves.

Pipeline contractors will get some business from the sale. Columbia will expand its facilities east and north from Alexandria to handle the new supply. Engineering studies are being made now to determine whether this will be by looping or additional horsepower. Monterey also must build 216 miles of 30-in. line.

New tack urged in making use of process analyzers

MORE AND MORE people are thinking of using computers for process control.

This means more has to be learned about processes, and the information must be obtained faster.

R. M. Green of the Foxboro Co. made these points at the ISA Symposium on Instrumental Methods of Analysis in Houston last week.

We have gone about as far as we can with environmental control such as temperature and pressure, Green said. A big avenue for further development is the process stream analyzer, already a major factor in computer-control application.

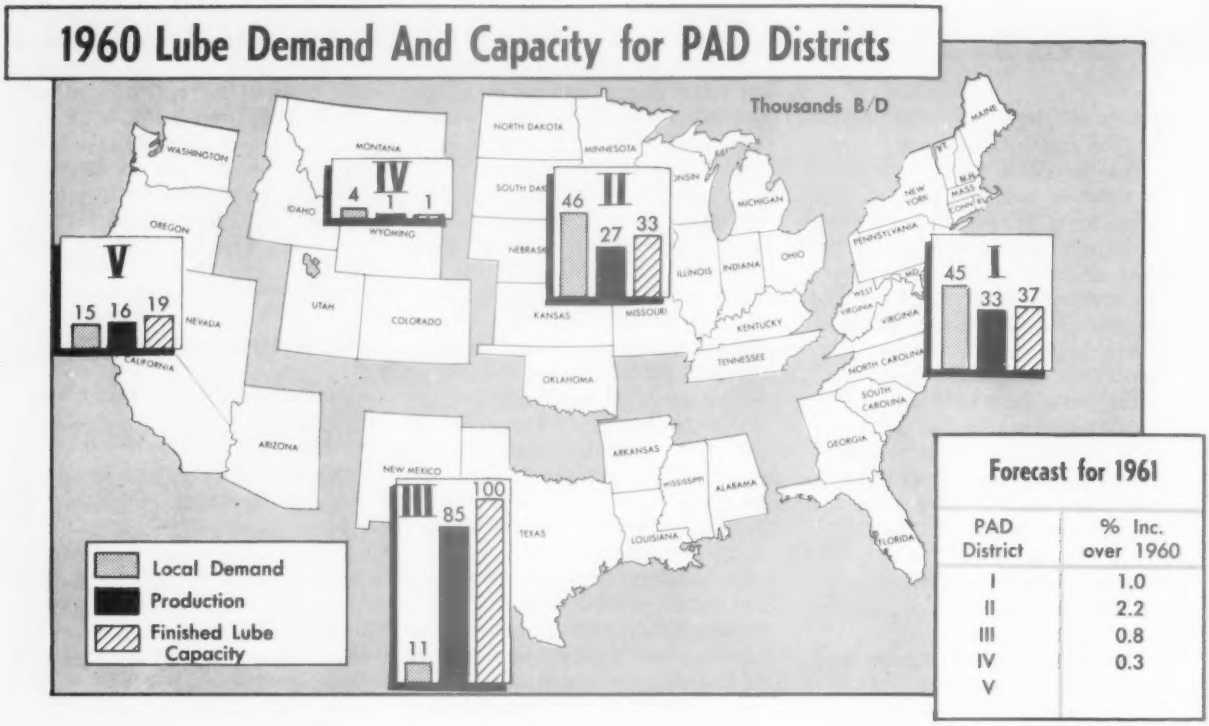
Green suggested a new approach in taking advantage of this versatile tool: Use nonspecific analyzers to develop over-all process information rather than concentrations of each component. Each stream constituent contributes differently to the total nonspecific measurement.

The next step is determining the effect each stream component plays in the total nonspecific analyzer reading and writing equations to define these relationships. Computers then solve the equations to develop desired analyses and control information.

Examples of nonspecific measurements are conductivity and specific gravity.

Green said the advantages of the nonspecific process analyzers are: They are faster, more rugged, simpler, require less maintenance, and usually may be put directly into the process stream.

They also operate with less complicated sampling systems than the specific instruments, Green said.



Lube-Oil Demand: Slight Increase Predicted

AN INCREASE of 0.6% in lube-oil demand is forecast for 1961, raising domestic and export requirements to 165,500 bbl. daily.

Total U. S. consumption is expected to be 120,500 bbl. daily, a decline of 0.6% from the 1960 figure. But a 4% increase in export demand to 45,000 bbl. daily will be more than enough to cancel out the domestic decline.

This is the picture presented by J. A. Coble, manager of Mobil Oil Division, economics and special studies department, Socony Mobil Oil Co., Inc., at the National Petroleum Association meeting in Chicago.

Coble's annual forecasts have come to be accepted as authoritative.

His study indicates that motor-oil consumption will be up 1.2% and that gear-oil and grease consumption will rise 1.6% in the U. S. this year. This will be offset by a 3.2% drop in consumption of industrial-type lube oils because of the economic slowdown.

1960 pattern . . . Total demand last year was up 3% to 164,000 bbl. daily.

This was divided into these categories:

Automotive, 70,000 bbl. daily, no change from 1959; industrial, 51,000 bbl. daily, up 1% for a domestic total of 121,000 bbl. daily, a slight gain; and exports 43,000 bbl. daily, up 10%.

Principal factors in the 1960 demand picture were these:

. . . The motor-oil ratio continued to decline as the drain interval lengthened.

. . . Industrial production averaged 3% higher, but more efficient operations reduced the lube oil needed per unit of output. And year-end business declines hurt large lube consumers.

. . . Booming economies in many foreign areas spurred a rapid gain in demand abroad.

. . . Lag in completion of new lube capacity firmed up the market.

The NPA survey of lube capacity shows an increase of 7,000 bbl. daily in finished capacity during 1960.

This compares with an increase in "average" capacity of 4,000 bbl. daily. Production last year increased 8,000 bbl. daily.

The annual survey also shows a finished lube capacity of 189,265 bbl. daily for U. S. refiners. Canadian plants had an additional 6,750 bbl.

Future prospects . . . Coble sees good prospects for demand growth abroad, but he is less certain about the future U. S. share of this market.

"We were unduly pessimistic about U. S. exports during the past 2 years and we could be wrong again," he said.

Coble foresees an eventual decline in U. S. exports. But for 1961 the outlook is for a 6% increase in foreign lube demand, and a 4% gain in exports from the U. S.

There are several negative factors affecting the lube market. Among them are longer crankcase drain periods, the approach of the "greaseless" car, smaller crankcase capacities, and more efficient use of industrial lubricants.

However, Coble points out that there will also be a trend toward premium, high-quality products which will result in a growth in value of lube sales.

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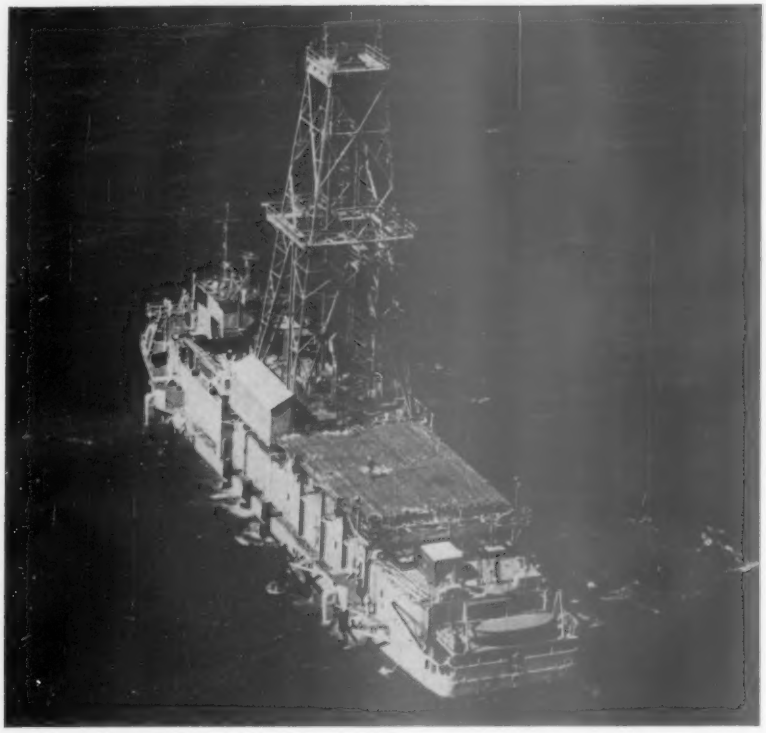

CUSS I drilled five holes off Baja California in 11,706 ft. of water.

Mohole Test Drilling Ends

DRILLING the Mohole is a big step nearer reality thanks to the core drilling recently completed off Baja California near Guadalupe Island.

Five holes were drilled during the 18 days the drill ship CUSS 1 was on location. The five holes totaled 2,444 ft. with the deepest going to 601 ft.

One hole to 1,500 ft. was planned, but the bit hit basalt at 556 ft. below the ocean floor.

Finding basalt at this shallow depth caused the project engineers to decide against going for the target depth of 1,500 ft. Drilling deeper into the basalt would not have produced any additional information.

Scientifically the drilling was considered a success since it produced cores at depths deeper than any previous ocean cores. And as far as the oil industry is concerned, the Guadalupe tests opened much deeper water to exploration. The drilling location was in water 11,706 ft. deep.

Global Marine Exploration Co., contractor on the job, says the Guadalupe drilling proves a wildcat can be drilled in water this deep (OGJ, April 10, p. 72).

In addition to coring the holes, logs were run in some. Seismic shots up to 50 lbs. were fired in one hole with geophones on the bottom of the hole and 12,272 ft. below the surface of the ocean. The final well was drilled with a French manufactured turbodrill.

Conventional rotary equipment was used on the other holes.

Next step . . . It is expected to take about 2 years to pick a site and build equipment for the actual Mohole, which will go about 15,000 ft. into the ocean floor.

Just what type of equipment will be used for the Mohole has not been determined. The AMSOC committee of the National Academy of Sciences, may convert a floating dry dock to a drill ship or build an automated drilling rig, but conventional drilling equipment probably will be used.

Kennedy Tax

PRESIDENT Kennedy sent to Congress last week a wide range of tax proposals, many of which, if adopted, would affect all segments of the oil industry as well as industry and business generally.

The President said the proposals are only a starter, aimed at stimulating the economy and eliminating certain defects and inequities.

Long-range, he wants a major overhaul, and plans to present such a program to Congress next year.

The proposals include tax credits for plant expansion, a plan for tax withholding on interest and dividends, a crackdown on expense-account tax deductions, and a tightening of taxes on most cooperatives.

Meanwhile, the President said, it would be necessary to extend the present corporation and excise taxes at the present rates.

The President made no mention of oil's percentage depletion in his message, despite earlier speculation that he would probably call for a study of that issue.

The only specific oil-tax mention concerned aviation fuel. The President proposed extending the present net tax of 2 cents a gallon on avgas to jet fuels for fiscal 1962, and then increasing each at the rate of ½-cent a year "until the portion of the cost of the airways properly al-

PIPELINE

One of the most expensive-per-mile pipeline projects ever undertaken is an 11-mile 36-in. line being installed in Chicago by Peoples Gas Light & Coke. More than 500,000 man hours will be required for the job, which will cost an average of $800,000 per mile. Route is from Peoples' Calumet station to 58th st. and Damen ave.

Related projects involving 470 miles of pipeline have been approved by an FPC examiner. Included are three Northern Natural Gas projects totaling 382 miles and a Michigan Wisconsin Pipe Line project of 88 miles. The Northern program would cost $37.5 million

Proposals Cover Jet Fuels, General Areas

locable to civil aviation is substantially recovered by this tax."

He repeated an earlier recommendation that revenues from aviation fuels be retained in the general fund rather than "diverted" to the highway trust fund.

Tax incentives . . . To encourage firms to modernize and expand, the President recommended an investment tax incentive in the form of a tax credit of:

. . . Fifteen per cent on all new plant and equipment investment expenditures in excess of current depreciation allowances.

. . . Six per cent of such expenditures below this level but in excess of 50% of depreciation allowances, with 10% on the first $5,000 as a minimum credit.

This credit would be taken as an offset against a firm's tax liability, up to an over-all limitation of 30% in the reduction of that liability in any year. It would be in addition to normal depreciation provisions.

The tax credit would apply only to expenditures on new plants and equipment located in the United States, and only to assets with a life of 6 years or more.

Foreign income . . . The President proposed elimination of tax deferral privileges in developed countries.

He said that more and more enterprises organized abroad by American firms have arranged their corporate structures to "exploit" the multiplicity of foreign tax systems and international agreements in order to reduce sharply or eliminate completely their tax liabilities both at home and abroad.

To correct this situation, Kennedy recommended legislation which would, after a two-step transitional period, tax American corporations each year on their current share of the undistributed profits realized in that year by subsidiary corporations organized "in economically advanced countries."

Expense accounts . . . Kennedy said there have been widespread abuses of expense accounts.

To end these practices, the President recommended that the cost of some business entertainment and the maintenance of entertainment facilities—such as yachts and hunting lodges—be disallowed in full as a tax deduction.

He also proposed that restrictions be imposed on the deductibility of business gifts, expenses of business trips combined with vacations, and excessive personal living expenses incurred on business travel away from home.

Capital gains . . . On the sale of depreciable business property:

"I recommend that capital gains treatment be withdrawn from gains on the disposition of depreciable property, both personal and real property, to the extent that depreciation has been deducted for such property by the seller in previous years, permitting only the excess over the original cost to be treated as capital gain."

The remainder should be treated as ordinary income, he added.

Withholding tax . . . The President is seeking legislation to provide for a 20% withholding rate on corporate dividends and taxable investment-type interest.

He suggested a system which would not require the preparation of withholding statements to be sent to recipients.

Dividend credit . . . The present law providing for exclusion from income of the first $50 would be repealed under the proposals made by the President.

Now that the President has sent up his tax proposals—proposals which he said should be enacted now—the next step will be up to the House ways and means committee, which handles all tax measures.

BRIEFS . . .

and the latter job would cost $6.5 million.

Natural gas for irrigation pump engines will be distributed in a 50-mile system of ¾-in. to 8-in. pipelines planned by Rio Grande Gas Co. The system will run from 12 miles north to 12 miles south of Las Cruces, N. M., along the Rio Grande River.

Latest proposal for a condensate-gathering system in Alberta has been made by Alberta Gas Products System, Ltd. The main line, about 360 miles long would run from the U. S. Border to a point southeast of Edmonton and would consist of 8⅝, 10¾, and 12¾-in. pipe. Laterals would connect with 15 gas-recovery plants. Products could move eastward via Interprovincial or westward via Trans Mountain.

Budget-type construction proposals have been approved by FPC for Trunkline Gas Corp., $2.5 million, and for Cities Service Gas Co., $3 million. Similar approval is being sought by Texas Gas Transmission on a $6-million proposal and by Transcontinental Gas Pipe Line on a $1.5-million plan.

Canadian pipeline deliveries totaled 315,200,874 bbl. in 1960, an increase of 2.2% over 1959. They included 49,250,219 bbl. of refined products, up 4.6% from the year before. Four new systems began reporting in 1960: Alaska-Yukon Pipelines, Ltd., Yukon Pipelines, Ltd., the Windfall system of Hudson's Bay Oil and Gas Co., and Trans Prairie Pipe Lines (B. C.), Ltd.

Product pipeline deliveries in the U.S. set a record of 1,048,695,000 bbl. in 1960, an average of 2,865,000 bbl. daily. The Association of Oil Pipe Lines, which compiled the figures from Bureau of Mines reports, says the daily average compares with 2,799,000 bbl. in 1959. Biggest proportionate gain was made by natural-gas liquids, up 25%.

Today's Discoveries Are Yesterday's Dry Holes

Welex's Simplified Logging Program today logs many discovery wells in areas once called "dry hole" country.

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Introduced to eliminate confusion and complicated computations, the Welex program within minutes gives you the answers to the two main questions — WHAT IS THE POROSITY and WHAT IS THE FLUID SATURATION.

Based on only two factors — type of porosity present and drilling mud/formation water salinity contrast — the Welex Simplified Logging Program makes selection of the BEST LOGGING PROGRAM for every well easy, as shown by the diagram here.

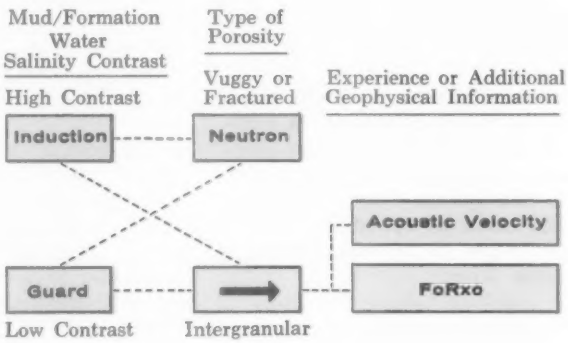
The addition of Welex's Acoustic Velocity Log to the program makes even more information available to you. The Acoustic Velocity Log, with Caliper of course, is the ideal choice in:

1. Formations where experience or past performance indicates that its porosity values are more accurate.

2. Areas where velocity data is desired for geophysical purposes.

As with the Welex FoRxo and Neutron Logs, you can read porosity values directly off the Acoustic Velocity Log. When run in conjunction with the Welex Induction or Guard Log, your most important question — WILL THE WELL PRODUCE? — can be answered in minutes by using the Simplified Interpretation Charts or "pigtails" printed right on the log.

The Welex Simplified Logging Program IS THE ANSWER for your well.



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New Device Automatically Analyzes Catalyst

- **Gulf instrument saves 14 hours of laboratory work, aids research.**

GULF OIL CORP. has developed and licensed what it says is the world's first automated catalyst analyzer.

The company said the new device, a product of Gulf Research & Development Co., has "updated catalysis research by several years" and is being used by Gulf to develop superior catalysts.

A researcher can set up the device and leave it unattended.

American Instrument Co., Silver Spring, Md., has been licensed by Gulf to manufacture and market a commercial model.

Gulf scientists said that in testing a catalyst with the device, they first evacuate all air from the sample and cool it to −319°. Then the analyzer doses the sample with small, controlled amounts of nitrogen gas on a pre-set schedule.

Pressure is recorded continuously during the process. When atmospheric pressure is reached, the device reverses the cycle by automatically removing the nitrogen gas.

It is the changes in gas pressure, which becomes atmospheric when all pores in the catalyst are filled, that provide the data needed for analyzing the catalyst.

Basic information is fed to an electronic data-processing machine for calculating the catalyst's total surface area, its pore volume, and the size distribution of its interior holes.

In the past, Gulf said, an analytical chemist had to spend 14 hours taking measurements to examine one sample. This was almost prohibitively expensive.

CATALYST samples being prepared for automatic test by new Gulf analyzer.

PROCESSING BRIEFS . . .

Gas-processing facilities are planned near Hennessey, Okla. with a capacity of 62,000 M.c.f. daily of gas from the Dover-Hennessey area. Completion is expected before the end of the year. Humble will be the operator.

An oxo alcohol plant will be built at Portsmouth, Ohio, by Oxo Chemicals. The grass-roots plant is scheduled to be completed early in 1962. It will produce isooctyl and decyl alcohols from olefin hydrocarbon vapors. Fluor Corp. is building the plant.

Expansion of crude-processing and catalytic-cracking facilities at Consumers' Co-Operative Refinery in Regina, Sask., will raise capacity from 16,000 to 22,500 bbl. daily. Refinery Engineering Co. of Calgary, Alta., has the contract for the $750,000 job which will start by June 1 and is expected to be completed by November.

A second polyolefins unit is under construction at Hercules Powder Co.'s Lake Charles, La., plant. The unit will have a capacity of 60 million pounds per year when it goes on stream in 1962. This will give the Lake Charles plant a total capacity of 120 million pounds of high-density polyethylene and crystalline polypropylene.

Contract to build a 30,000 M.c.f.d. gas-processing and sulfur-recovery plant has been awarded to Brown & Root, Inc. by Shell Oil Co. The plant will be located in the Bryans Mill field in Cass County, Texas. The plant is scheduled to go on stream in November.

Construction work on Standard Oil Co. of Ohio's new Isocracking facilities started April 10 at the Toledo, Ohio, refinery. Completion of the 7,500 bbl. daily unit is set for November. Ralph R. Parsons Co. is constructing the unit.

A 10,500-bbl. propane deasphalter costing $3.6 million has been placed in operation at Sun Oil's Toledo refinery. The unit will reduce the heavy-fuel-oil yield and provide increased catalytic-cracking stock. Foster Wheeler did the engineering design and construction of the unit, and Sun handled the auxiliary facilities.

"A great step forward with your Planetary Gears, Big Bearings and Cylindrical Crossheads."

— J. K. Butler

OIL PRODUCTION MAINTENANCE, INC.
7440 CHOCOLATE BAYOU ROAD -- P. O. BOX 14291
HOUSTON 21, TEXAS
August 31, 1960

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The Wheland Company
Chattanooga, Tennessee

Dear Mr. Street:

Our Wheland Planetary Pump is giving us increased penetration and good savings on bits. We know from more than 18 months of constant operation on 10,000 Ft. wells that our savings are substantial.

We have kept an accurate record on operating costs and all maintenance costs and are especially impressed by the low cost of fluid end expendables. The HP-16000 Pump has constantly operated near its rated capacity on more than 200,000 feet of hole in the Texas Gulf Coast Area.

We are now operating Wheland HP-18000, HP-14000, and HP-16000 Pumps and are glad to recommend them. Your new HP-16000 Pump design is a great step forward with your planetary gears, big bearings and cylindrical crossheads.

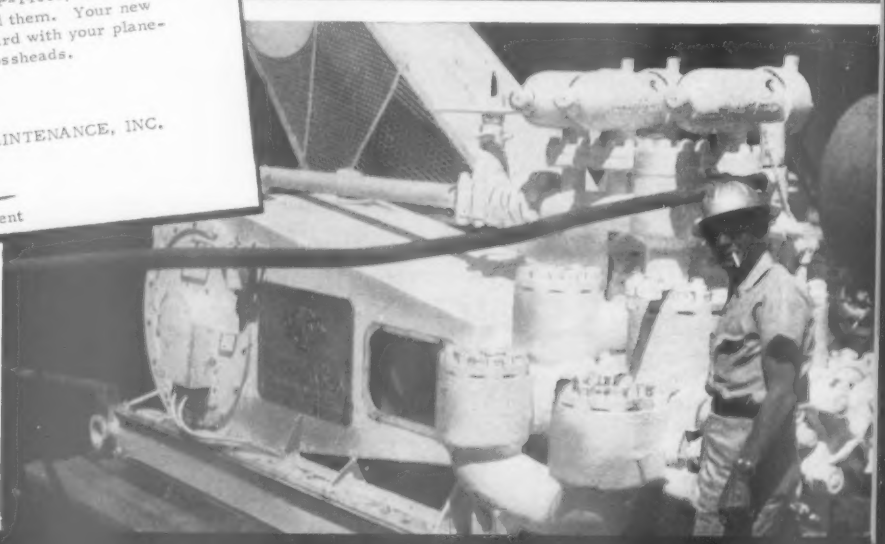
Yours very truly,

OIL PRODUCTION MAINTENANCE, INC.

J. K. Butler

J. K. Butler, President

WHELAND PLANETARY
HP-16000 PUMP
Duplex Power Slush Pump
7¾" x 16", 600 H.P. at 65 RPM



Wheland HP-16000 Planetary Pump owned by Oil Production Maintenance, Inc., on location in the Gulf Coast area.

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Heaviest Tubing String Set in Texas Well

• At the Atlantic Refining 1 J. C. Kelly in Pecos County, a 325,000-lb. string of alloy tubing has gone down more than 15,000 ft. The well in the new Hershey field also holds the Texas depth-production mark.

A THICK WALL, alloy tubing string weighing 325,000 pounds—the heaviest that ever went into a well—has been set in Atlantic Refining's 1 J. C. Kelly in the Hershey field of West Texas.

Depth of the string is 15,791 ft.

The well also holds the depth record for production in Texas. It has been completed for gas production in the Devonian, Fusselman (Silurian), Montoya, Ordovician formation at 15,831-16,680 ft.

There are 371 joints of 4-in. o.d. and 114 joints of 4.5-in. o.d. in the string, which was manufactured by Babcock & Wilcox Co., Beaver Falls, Pa., and supplied by Houston's Atlas Pipe, Inc.

Another Houston firm, Hardy-Griffin Engineering Corp., finished the tubing with its HG "DSS" Teflon seal-box and pin connections. Then the tubing was plastic-lined to no-holiday specifications.

The 1 J. C. Kelly is the discovery well in Hershey field, 30 miles west of Fort Stockton. It kicked off a big land play in the area (OGJ, Mar. 7, 1960, p. 64).

On a recent test the Pecos County well produced at a rate of 32,600,000 cu. ft. daily through 1-in. choke, with 1,700 psi. surface tubing pressure. Shut-in tubing pressure at the surface was 5,500 psi.

The well originally was drilled to a depth of 19,696 ft., penetrating 1,169 ft. into the Ellenburger. Seven-inch casing was set for 16,211 ft. and 5-in. liner was set between 16,121 and 19,694 ft. When tests of the Ellenburger failed to get production, the cased hole was plugged back to 16,820 ft.

Previous holder of Texas' deepest-production record was the Statex 3 McAdams in Grayson County, North Texas, at 16,540 ft.

The 1 J. C. Kelly is one of half a dozen significant and widely separated strikes that were made in the sprawling Delaware-Val Verde basin area during 1960 (OGJ, Feb. 13, p. 54).

In addition to the Hershey field, two other big gas fields were brought in last year.

They are the Rojos Caballos field, brought in by Mobil Oil Co., and the Yucca Butte field, discovered by Shell and Humble.

MORE joints are added as the world's heaviest tubing string is set in the 1 J. C. Kelly.

Honolulu Sale Due in May

• Tidewater will take California properties and half of Honolulu's Alaskan holdings. Pan American gets rest.

SALE of Honolulu Oil Corp. to Pan American Petroleum Corp. and Tidewater Oil Co. is scheduled to be completed early in May.

Pan American and Tidewater are expected to pay Honolulu about $90 a share for its assets. This would make the purchase a $337,587,480 deal based on Honolulu's 3,750,972 shares of outstanding stock.

The $90 figure is the initial liquidation payments expected to be made to stockholders. A second payment is likely, so the price will be higher than a straight $90 a share calculation. However, this second payment probably will be a small one.

L. S. Cranson, Honolulu's president, told a stockholders meeting in San Francisco last week that the sale should be closed by September 1. He said a sales agreement has been drawn up and should be signed early in May.

The sales agreement will have to be signed by May 15 if present plans are followed. May 15 is the expiration date on the Pan American-Tidewater bid and for several other bids submitted.

According to Cranson's stockholder report, Tidewater will be the minority partner in the sale. Tidewater is buying only the California properties and half Honolulu's Alaskan holdings (leases on 101,000 acres) and Pan American gets the remainder.

Honolulu's daily production is running 51,000 bbl. of crude, 3,200 bbl. of natural gas liquids, and 61,000 M.c.f. of gas. California accounts for about 25% of the oil production and about 50% of the gas production.

During 1960 Honolulu's daily average oil production was 47,000 bbls. It was split the following way: Mid-Continent, 18,700 bbls.; California, 12,800; Rocky Mountains, 9,600; and Canada, 5,900.

The purchase still must clear the Justice Department which hasn't said whether it will approve.

Area Pricing Talks Fizzle

- Lack of headway in pre-hearing conference may prompt FPC to launch formal hearing on the pricing approach.

THE PRE-HEARING conference on the area-pricing approach to natural-gas regulation appears to have bogged down beyond all hope of further progress.

Another session has been scheduled for this week in Washington, but the main purpose will be to put into the record a report of what was done at the off-the-record conference there April 12-13.

Since virtually no headway was made, there will be very little to put on the record.

Technically this week's meeting will be open to new suggestions, but no one has much hope that any real progress can be made.

Next step . . . After this week's conference, Edward Marsh, the Federal Power Commission's chief hearing examiner, will make a report to the commission and let it decide the next step.

Conceivably, the commission could request further conferences in an effort to decide what information should be submitted in area-price hearings, what form it should take, and other issues that are still unresolved.

More likely, the commission will abandon the conference approach and order the FPC staff to proceed with a formal area-price hearing. Such a hearing would not begin for several months—probably not before this fall at the earliest.

Producer approach . . . When an area-price hearing eventually is held, there is a good chance that producers will present as a group the evidence they feel is necessary.

It is quite likely that the FPC staff will call for additional data, and other groups may demand that certain information be submitted—including individual company cost information.

This would set in motion the slow, tedious process of examiner findings, commission rulings, and court tests.

It was in the hopes of avoiding this slow-motion procedure that the commission instituted a pre-hearing conference.

The conference began in Midland in March, adjourned after two days, resumed in Washington in mid-April, and recessed again.

NPA Directors Approve Merger

THE last important obstacle to formation of the National Petroleum Refiners Association has been removed.

At Cleveland last week the board of trustees of the National Petroleum Association approved the merger.

Just a week before, similar action was taken by directors of the Western Petroleum Refiners Association. By midyear approval is expected by the membership of both groups.

First meeting of a new board of directors, made up of each of the some 60 member companies, will then be held. Action of the NPA board was announced by R. S. Blazer, board chairman of Ashland Oil & Refining Co. and president of NPA. Following membership approval, three trustees from each association will draw up a new constitution and by-laws for NPRA. The group also will nominate an executive committee.

The natural division of functions already established—WPRA in the field of refinery technology and NPA in government and labor relations—will be continued. But neither Tulsa nor Washington will be designated as national headquarters, Blazer said.

Officers and directors of NPRA will be elected at a spring meeting to be held in San Antonio each year. A fall meeting will be held in Atlantic City, where NPA has held its annual meeting every year since 1902.

Meetings probably also will be held annually in Cleveland, for members having a particular interest in lube-oil manufacturing and related specialty items.

Interior May Halt Brownsville Imports

GOVERNMENT officials were drafting plans late last week to halt or reduce sharply the shipment of exempt crude oil from Mexico into Brownsville, Tex. It was understood the shipments were to be halted until Interior Department could draft new rules to cover the situation.

The oil is brought in by tankers, and normally would be subject to import controls. But an earlier ruling permitted such shipments under bond without quotas.

The oil was then trucked across the border into Mexico and back into this country as "overland" shipments—exempt from quotas.

Producers have complained that this evaded import regulations and should be stopped. Increase in such shipments caused Interior to review the problem (OGJ, Apr. 17, p. 84), leading to a decision last week that something would have to be done.

Map-Theft Ring Found

HOUSTON police said last week they have uncovered a huge operation of stolen or bootlegged maps.

They charged three men with felony theft, one of whom had about 4,000 survey maps of seven companies in his possession.

Charles Leroy Moore, 61, Houston oil man and map dealer, told police in a three-page statement he obtained maps from employes of blueprint firms. Four years ago, he said, he received $5,000 from a Houston oil company president for two footlockers filled with maps.

Refrigerated-LPG Imports Race On in Japan

• Growing demand sparks competition by three firms to be the first to move bottle gas from Saudi Arabia and Kuwait facilities. Shipbuilders are rushing work on two LPG tankers and another vessel is being modified for hauls.

JAPAN will start importing refrigerated LPG from the Middle East in a big way by the end of the year.

Three local companies are vying with each other to be first to bring in supplies of bottle gas from new refrigeration facilities in Saudi Arabia and Kuwait.

Two new tankers to carry the product are under construction, and a third vessel is being modified for use as a refrigerated-gas carrier.

The race is spurred by a soaring demand for LPG for domestic cooking and heating, industrial fuel, chemical feedstock, and for blending with coal gas.

Demand for liquefied-petroleum gas from refineries rose from 124,000 tons (about 1,438,000 bbl.) in 1958 to 331,000 tons (about 3,840,000 bbl.) last year. Output from petrochemical plants raised this total by another 15%.

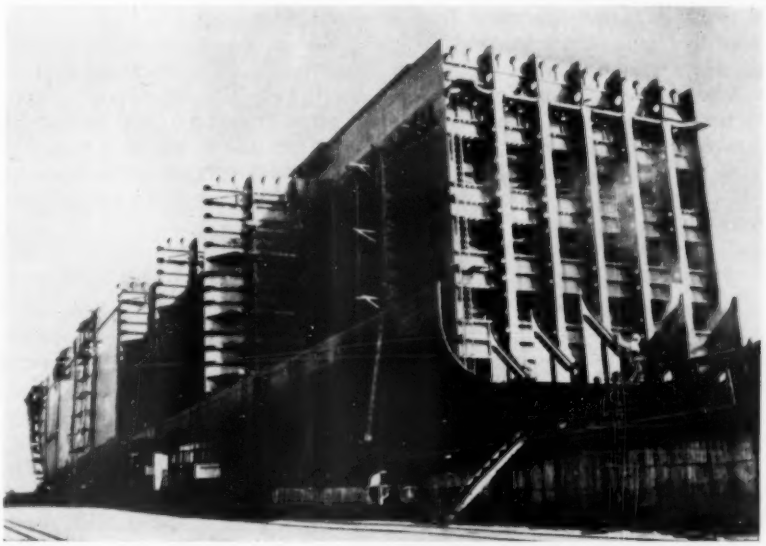
But local refineries no longer can keep up with the market. Last year there was a shortage.

This year LPG imports of 149,000 tons (about 1,728,000 bbl.) will be needed to make up the difference. By 1963, imports of 311,000 tons (about 3,608,000 bbl.) will be needed.

Who's involved . . . General Gas Co. appears to be in the lead in developing facilities. It will bring in its first shipments of refrigerated LPG toward the end of this year.

Two other companies, Nippon Oil Co. and Bridgestone LP-Gas Co., will not be far behind. Both are expected to start bringing in the LPG by early 1962.

General Gas is a new company set up in 1959 for the sole purpose of importing and marketing LPG. General Bussan K.K., a local marketer, owns 30%, Stanvac has 25%, and other companies in the Mitsui financial group hold 45%.



JAPAN'S FIRST refrigerated-LPG tanker is being built for General Gas Co. by Mitsui Shipbuilding at the construction firm's Tamano docks.

Stanvac will supply LPG from its 1,370-bbl.-daily refrigeration plant at Ras Tanura, Saudi Arabia. This represents a 40% share of an available 3,420 bbl. daily from the Aramco plant. It is equivalent to its parents' interest in Aramco. Jersey Standard holds 30%, and Socony Mobil, 10%.

A combination crude-and-refrigerated-LPG tanker, which can carry 38,000 tons of crude and 4,700 tons of LPG, is now under construction at Mitsui Shipbuilding Co.'s Tamano docks.

The $7.9-million vessel, which will be completed in October, is owned by General Kaiun (Shipping) Co. A loan of $4.2 million from Chase Manhattan Bank is financing part of the cost.

The first shipment of LPG is scheduled to arrive from the Middle East by the end of the year. Eight voyages a year are planned thereafter.

General Gas has under construction a $5.2-million terminal at Kawasaki to handle the gas. This will include seven 1,300-bbl. spheroidal tanks, and two 63,000-bbl. refrigerated-LPG tanks. Secondary terminals are planned at Nagoya and Osaka.

General Bussan and other companies will be sales agents.

Nippon Oil, an affiliate of Caltex and the largest marketer in Japan with 20% of the market, also will import its LPG from Ras Tanura.

Caltex, whose parents Texaco and California Standard each hold 30% of Aramco, will supply Nippon Oil from its 2,050 bbl. daily available at Ras Tanura, or 60% of Aramco's output.

Nippon Oil has purchased a T-2 tanker from Caltex. The ship is being converted into a crude-LPG carrier capable of carrying 14,450 tons

of crude and 5,200 tons of LPG.

Receiving facilities are being built at Kawasaki. The $2.2-million terminal will include an 80,000-bbl. tank for refrigerated propane and a 40,000-bbl. tank for refrigerated butane. A 6,300-bbl. tank will hold pressurized butane.

Chicago Bridge & Iron Co. is an adviser on the project. Ishikawajima-Harima Heavy Industries is the contractor.

Most of the LPG will be distributed for household use by a subsidiary, Nippon Oil Gas Co. Some will be used as a petrochemical feedstock by Nippon Petrochemical Co., another subsidiary.

Bridgestone LP-Gas Co., owned by Bridgestone Tire Co., is the only non-oil company going into the LPG business. British Petroleum will supply up to 2,770 bbl. of LPG from a new refrigeration plant under construction in Mina al Ahmadi, Kuwait.

A $10-million tanker to be used exclusively for LPG transportation is under construction at Mitsuibishi Nippon Heavy Industries Co.'s Yokohama docks. The vessel will be completed in April 1962. It will carry 15,000 tons of LPG. The vessel is designed for later conversion to shipments of liquefied methane.

Bridgestone has a technical assistance contract with Conch International Methane Ltd., which developed the "Methane Pioneer," the original refrigerated methane carrier for design of the LPG carrier (OGJ. Mar. 6, p. 79).

Conch, owned 40% by Continental Oil, 40% by Royal Dutch-Shell, and 20% by Union Stock Yard & Transit Co., will receive 10 cents per gallon of tanker capacity, and 1 cent per gallon of onshore-receiving-tank capacity for its services.

The $2.2-million onshore facilities at Kawasaki will include three receiving tanks—two of 130,000-bbl. capacity each and one of 100,000-bbl. capacity.

The LPG will be distributed through the network of Nippon Express Transportation Co., the country's largest shipping and transportation firm. The company has set up a sibsidiary, Nittsu LP-Gas Co., to handle sales.

Others . . . Idemitsu Kosan, an independent and the second largest marketer in the country, reportedly is planning to import LPG from Warren International, a Gulf Oil subsidiary which will have the other half of Kuwait's LPG. Details have not been disclosed.

A tie-up proposed earlier between Warren and Mitsubishi Shoji (Trading) Tokyo Gas has been cancelled because of the Japanese firm's interest in natural gas from Teikoku Oil's Kubiki field in Niigata Prefecture.

Phillips Takes Hand in Libya's Oil Play

PHILLIPS Petroleum has joined the Libyan oil play by winning three concessions that were parts of blocks relinquished last year by other companies.

Phillips and Pan American Libya Oil Co. (Indiana Standard) were awarded a total of 18,650 sq. km. (about 7,190 sq miles)—in Tripolitania, Cyrenaica, and Fezzan.

Pan Am's three new blocks, all in Cyrenaica, northeastern Libya, give the company its first acreage relatively close to the Mediterranean coast.

A third company, Cia. Richerche Idrocarburi (CORI) was unsuccessful in the first round of awards on a total of about 19,300 sq. miles turned back by companies last year.

The acreage was given up under the terms of the Libyan oil law which requires operators to surrender 25% of every concession after 5 years (OGJ, Mar. 20, p. 86).

One of the Phillips concessions is in northern Fezzan along the Tunisian border. Now called Block 90, the acreage is the block 26A-North area given up by Oasis Oil. Oasis has two discovery wells in the part of the acreage it retained (OGJ, Apr. 17, p. 88).

The new Phillips area covers 6,578 sq. km. (about 2,540 sq. miles).

The other two blocks are in Tripolitania. Block 91 is an 830-sq.-mile area formerly termed Block 25A. It was turned back by Oasis, which has drilled one dry hole in the area.

Block 92 is Mobil Oil's former 600-sq.-mile area in Block 11B. Mobil has drilled three producing wells of up to the 1,500-bbl.-daily class elsewhere in the concession.

Pan Am areas . . . Acreage won by Pan Am lies in the North-Central Libyan region where the country's most prolific production has been found so far.

The company's 870-sq.-mile Block 93 consists of acreage turned back by Esso Sirte on Block 20, and by Amoseas on Block 47. The area lies midway between Oasis' Dahra oil field to the west and Esso Libya's Zelten oil field to the east.

Block 94 is a 690-sq.-mile area turned back by Mobil on Block 13. The acreage involved lies northwest of Zelten. Block 95, covering 1,670 sq. miles, comprises Block 6 acreage turned back by Esso Libya, and Block 12 acreage Mobil gave up.

The Italian firm, CORI, was ruled ineligible to bid on its application for Block 26A-South. Phillips put in a bid for the area and later withdrew it, but kept alive its offer for the 26A-North area.

Sun Out of Race

SUN OIL CO. is dropping out of the race for concession acreage in Libya, but is continuing its exploration and producing activities in other foreign areas.

J. G. Pew, senior vice president, disclosed that Sun has "changed its mind" about any attempts to acquire concessions in Libya.

He added, however, that the company and three partners will undoubtedly start a well in the Spanish Sahara this year "if our folks can get enough military protection."

A Union Oil Co. search program in the northern part of the country has been hampered by a border dispute between Spain and Morocco (OGJ, Apr. 17, p. 89).

India Pitches Into Big New Oil Hunt

• Apparent success of recent operations spurs the government into earmarking $44 million for exploration. The dramatic speedup of activities is being undertaken despite financial strain and a lack of trained personnel.

This is the second of a series of articles on India, a country that promises to become one of the world's most important oil markets in a matter of decades.

Ray G. Gibson
District Editor

INDIA IS STEPPING UP the pace of a fast-moving exploration program with all the enthusiasm of a novice wildcatter who has had a taste of success without any dry holes.

The government has allocated $44 million to the country's Oil and Natural Gas Commission for exploration in 1961-62. This is almost as much as the commission spent in the 5 years ending in 1960.

The agency is planning to put into the field over the next 2 years 21 geological, 18 seismic, and 14 magnetic parties, along with four logging teams and a number of shallow-well drilling teams.

The search will take place in Punjab, Gujarat, Assam, and other regions. Twenty-three heavy rigs and four structural rigs will be used to drill 39 deep tests and 15 structural tests. The commission expects to increase the number of rigs at its disposal from last year's 14 to 60 by 1966.

India will be hard-pressed to pay for this program.

Another handicap is a shortage of trained personnel. A large number of geologists, geophysicists, and drillers will have to be trained overseas.

But the government considers it has good reasons for a do-it-yourself oil search despite the obstacles. It is flushed with pride over apparent success in oil operations north of Bombay, and it is getting both moral and financial support from the Russians.

A. N. Kosygin, first vice chairman of the Soviet Council of Ministers, assured India during a recent visit that it would be possible for the nation to solve its oil problem "in the near future." In a new Soviet aid offer, exploration and transportation are expected to get $21 million of $52 million earmarked for the oil program.

The Socialist-oriented Indian Government has not turned its back entirely on private companies. But negotiations for new concessions are dragging and the government, either through contract or actual participation, is seeking ultimate control of operations.

Cambay and Ankleshwar . . . India is pushing ahead with development of Cambay and Ankleshwar oil fields. But how much oil it has and what will be done with it in the immediate future still are clouded questions.

Most evaluation work has been done at Cambay, about 300 miles north of Bombay. Drilling is on schedule with the nineteenth and twentieth field wells drilling ahead.

A dozen of the wells have been completed as producers. It hasn't been learned whether the remaining tests are noncommercial or whether some wells merely await completion. Several of the earlier wells were completed in the 300-to-500-bbl.-daily range.

The eighth producing well has been brought in at Ankleshwar, about 100 miles south of Cambay. But at least another eight wells must be drilled before the field's potential can be evaluated.

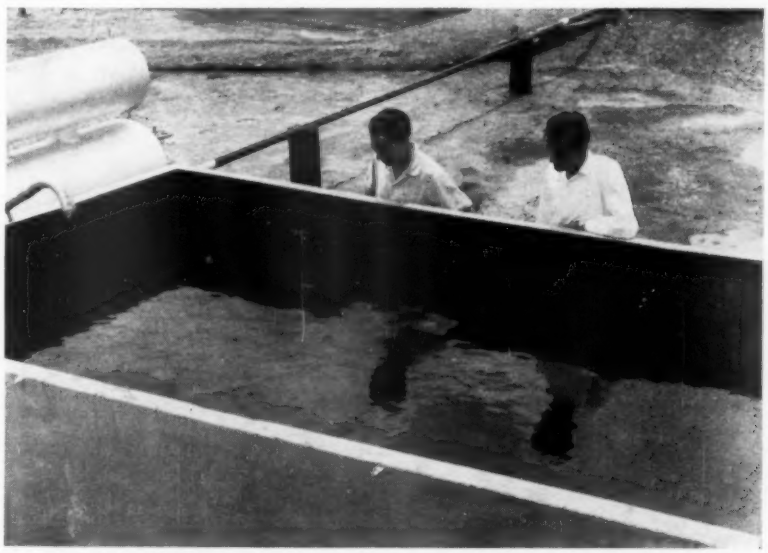
Crude of between 43°-and-46° gravity is produced from the 4,500-ft. range at Ankleshwar.

The initial discovery gave indications of being a 2,100-bbl.-daily producer. Whether the other field wells, or even the discovery, are likely to live up to this potential has not been disclosed.

A total of 200 wells are scheduled by 1966 for Gujarat, the state in which both Cambay and Ankleshwar are located. Most of the nine new rigs scheduled for duty in 1961-62 probably will be assigned there.

The Oil and Natural Gas Commission is budgeting nearly $10 million for purchase of the new drilling gear.

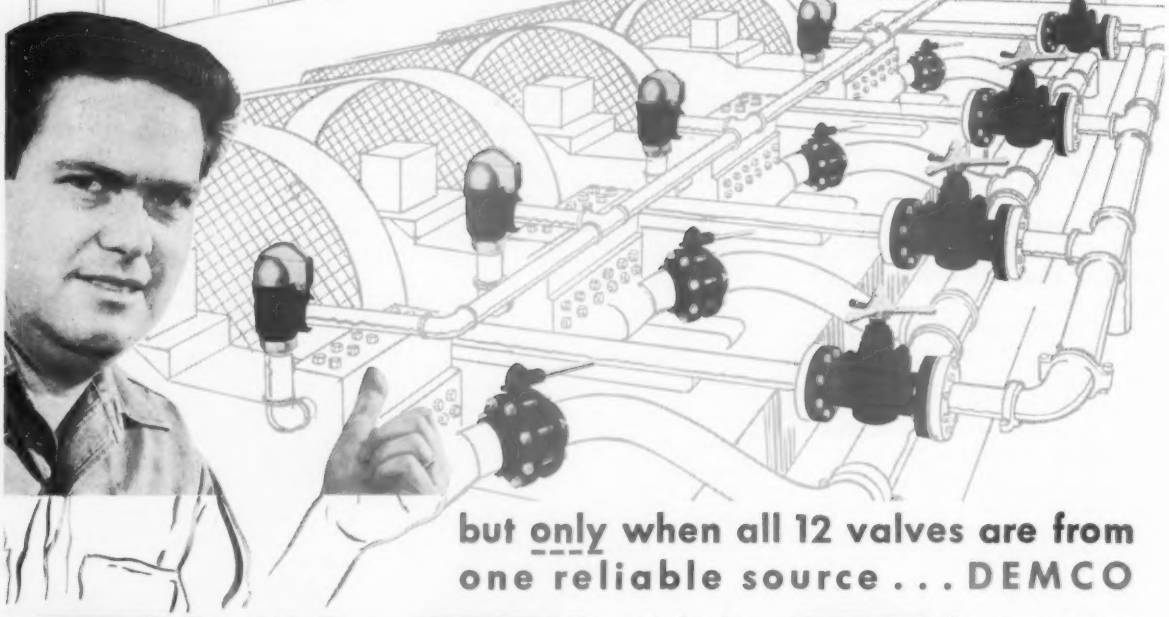
Russian, Romanian, and American rigs are operating side by side at Ankleshwar. The U. S.-made



TWO WORKERS check level of crude in an open tank at Ankleshwar field.

equation for efficient operation:

3×4=1



but only when all 12 valves are from one reliable source . . . DEMCO

Dependable Demco Safety Relief Valves provide maximum protection against excessive pump and line pressures and offer the ultimate in safety to workers. Built-in safety cap encloses shear bar and nail, yet opens instantly when line pressure shears the nail. Advanced Demco design insures immediate relief from excess pressure by use of a *single* nail for *all* relief settings on the shear bar. Available in standard cast steel valve and sub-assembly or non-corrosive bronze valve with stainless steel sub-assembly.

The exclusive features of Demco Butterfly Valves offer bubble-tight seals in pressure or vacuum applications for liquids, vapors, or solids. The Demco disc "floats" on the stem, without set screws or exterior fastenings, and finds its true center for a positive, non-directional shut-off. A one-piece Buna-N seat, bonded to steel, provides a stronger, larger contact area for disc, acts as stem packing and eliminates needs for gaskets or "O" rings between flanges. Only the Buna-N synthetic seat and corrosion-resistant metal disc are exposed to line flow. Factory tested in excess of working pressure, Demco Butterfly Valves offer quick in-line repair.

You can count on longer, trouble-free valve life—and, a *drop-tight* seal every time—with the rugged, corrosion-resistant Demco Gate Valve. Exclusive spread-ring seat construction gives you a *positive* rubber-to-metal seal without undue stem torque—durable, synthetic Buna-N against corrosion-resistant stainless, Monel, aluminum bronze or steel. Entire inner assembly lifts out for faster, easier *in-line* inspection. With Demco's unique design, fewer parts are subject to wear. Stem threads are self-lubricated and protected from corrosion by a *double* stem seal.

Wherever durability, reliability and safety are essential, on drilling and production installations all over the world, rugged Demco Valves have proved to be the answer. Choose all three or just one—but choose Demco!

All valves available in popular sizes and pressures at supply stores everywhere. Write Demco today for complete engineering details!

DRILLING EQUIPMENT MANUFACTURING COMPANY
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equipment consists of two National T-45's.

A preliminary agreement is reported to have been made for the refining of 1,500 tons (about 10,500 bbl.) daily of Ankleswhar crude at the Bombay refineries of Burmah-Shell and Stanvac, and commercial production may start in September.

The question of price and transportation costs remains to be settled. But Burmah-Shell will take 60% of the crude, and Esso Standard—which will assume control of Stanvac's Indian operations after the company is split up—will take the remainder.

The companies are seeking a fixed price based on the performance of the crude in their plants. Crude will move to Bombay by rail.

Handling of the crude by private refineries is expected to be on a temporary basis until the government opens its own plant in Gujarat in 3 or 4 years (OGJ, Apr. 17, p. 87). This will have a capacity of between 30,000 and 40,000 bbl., depending on the extent of local production.

Brahmaputra find . . . Another promising find has been made by the commission on the opposite side of India in Assam's Brahmaputra Valley. The discovery, at Rudrasagar, is below 10,000 ft. on a structure similar to that of Nahorkatiya and Moran oil fields to the east.

The area has long been recognized as a promising one. Burmah Oil, whose subsidiary, Assam Oil, made the Nahorkatiya and Moran finds, at one time claimed exploration rights in the Rudrasagar and Sibsagar areas. The company took court action to back up its claims, but dropped the case last year.

Exploration negotiations . . . Both private companies and Italy's ENI are seeking concessions in nonreserved areas.

Stanvac has requested a concession in Jaisalmer region of Northwest Rajasthan.

The area borders the West Pakistan region, where the company has a shut-in gas field at Mari with reserves estimated at 3.7 trillion cubic feet. The field is being considered as a possible source of gas for export sales to India.

Stanvac reportedly is willing to allow the government 25% participation in Jaisalmer region, as in an exploration program in Bengal basin which was given up last year. India is holding out for 50%.

Burmah - Shell's negotiations for exploration rights with the government is deadlocked on a question of marketing crude. The company is believed to be willing to offer crude to the government on a contractual basis, rather than refine it itself. But it insists on marketing all products and splitting profits on a 50-50 basis.

A team of negotiators from Italy's ENI is expected in New Delhi soon to work out an exploration pact.

THIS National T-45 is one of the two American - made rigs operating near Russian and Romanian rigs in Ankleshwar field.

FOREIGN BRIEFS . . .

Movement of headquarters for Gulf Oil's Latin American exploration operations is in the works. The division, formerly called the New York exploration division, is being shifted from New York to Coral Gables, Fla., and has been renamed the Western Hemisphere exploration division.

Prospecting is under way in the Sanghar and Khisar desert area of southeastern West Pakistan, where Pakistan Petroleum has been awarded exploration licenses.

The deepest well in the Russian Far North is projected below 13,000 ft. in the Nar-Yan-Mar tundra area near the mouth of Pechora River, about 75 miles north of the Arctic Circle.

Stepped-up exploration drilling is planned by Russia this year. The target is 16,730,000 ft. of wildcat hole against 12,800,000 ft. in field wells. Last year, exploration drilling totaled 13,120,00 ft. against 12,-140,000 ft. development drilling.

Five concessions in Zone 1 of Bolivia have been taken over by Bolivian California Petroleum Co., a subsidiary of Shell and Standard of California. Alaska International Corp. assigned the acreage to Bolivian California. The concessions cover 114,750 hectares (283,543 acres) and are 31 miles (50 km.) east of Santa Cruz adjoining acreage where Shell and Standard of California are now drilling a well.

A 20,000 - bbl. distillation unit will be built by Imperial Chemical Industries as a source of naphtha feedstocks for three of the company's olefin plants at Wilton, England. Shell-Mex and BP will supply crude for the unit, ICI's first venture in oil refining, and will take excess products.

Pan American has abandoned its second wildcat in Iranian waters of the Persian Gulf after reaching total depth of 12,497 ft. First well on the expensive concession is still being tested.

Rig Activity in Foreign Areas

	Apr. 1961	Oct. 1960	Mar. 1960
LATIN AMERICA			
Argentina	109	109	101
Bolivia	12	15	9
Brazil	55	39	42
Br. Honduras	1	...	1
Colombia	14	18	22
Chile	6	4	5
Costa Rica	...	1	...
Cuba	...	1	1
Dom. Rep.	1	1	1
Ecuador	6	3	5
Guatemala	1	...	3
Mexico	104	153	134
Panama	1	...	...
Peru	11	11	9
Trinidad	24	25	31
Venezuela	32	43	50
TOTAL	377	423	414
MIDDLE EAST			
Bahrain	1	1	...
Iran	13	14	13
Iraq	7	11	14
Israel	4	4	4
Jordan	...	1	1
Kuwait	4	3	3
Neutral Zone	6	6	5
Qatar	1	2	2
Saudi Arabia	4	3	3
South Arabia	3	2	3
Syria	2	2	2
Turkey	11	11	11
TOTAL	56	60	61
WESTERN EUROPE			
Austria	9	9	9
France	32	30	50
W. Germany	100	100	105
Greece	1	...	...
Italy	36	36	36
Netherlands	4	4	4
Spain	7	6	8
Switzerland	1	1	...
U. K.	4	4	5
TOTAL	194	190	217
AFRICA			
Algeria	48	38	45
Angola	3	3	3
Egypt	18	13	11
Senegal	1	1	2
Gabon	2	6	7
Gambia	1	1	...
Libya	31	35	31
Madagascar	1	1	2
Middle Congo	1	1	2
Morocco	1	1	1
Nigeria	4	5	8
Span. Sahara	1	1	...
Somalia	2	2	2
Kenya	1	...	...
Tanganyika	...	...	1
Tunisia	1	1	1
TOTAL	116	109	116
ASIA-PACIFIC			
Australia	4	4	5
British Borneo	2	2	2
Burma	4	3	4
Formosa	1	1	1
India	17	8	6
Indonesia	12	15	15
Japan	15	15	15
New Guinea (inc. Papua)	...	1	1
New Zealand	2	2	1
Pakistan	4	5	5
Philippines	1	3	3
Timor	1	1	1
TOTAL	63	60	59
GRAND TOTAL	**806**	**842**	**867**

NOTE: Estimates are made where complete up-to-date reports are lacking.

Foreign Drilling Dips, But Outlook's Good

- Better weather may soon make up for the slight skidding in overseas activity. A score of additional rigs have gone into operation recently.

FOREIGN DRILLING is below the level of last year but activity is picking up in some areas, possibly because of spring weather.

The latest Journal survey shows there are 806 rotary rigs on new hole this month, compared with 842 in October and 867 in March 1960. However, 20 additional outfits have been put into operation in recent weeks—notably in French areas.

Five more rotaries have gone into action in France itself, making a total of 32. Four more rigs are drilling in Algeria, raising the total there to 48.

Another 11 rigs have gone into operation in several other countries. Among these is India, where the government's Oil and Natural Gas Commission is stepping up its drilling program in Gujarat State (see story, p. 85).

U. S. operators had 1,617 rigs active early in April, while 99 outfits were drilling in Canada.

This brought the free-world total to 2,522.

Libyan play . . . While Oasis Oil Co. is taking the spotlight in Libyan exploration operations, other companies are nevertheless pushing ahead.

Esso Libya is keeping four rigs active—three in Concession 6 and one in Concession 8. Esso Sirte, the joint Esso-Libyan American operation, has three outfits active—one in Block 17, and two in Block 20.

CPTL is moving a second rig into Block 23 where the company has made a discovery in El. The rig, an Emsco GB 250 which has been stacked since last year, will drill the D2.

El, located in northwestern Libya southwest of Tripoli, is drilling ahead at 8,349 ft. following completion of a 3-week fishing job. The find is still to be tested.

Esso Sirte is bringing in another rig, a portable Desert Star, from the U. S.

Other active operators are Mobil, with 1 rig; Gulf, 2; Shell, 1; British Petroleum, 4, including one in the Bunker Hunt farmout area; Pan American, 2; Deutche Erdoel-WIAG, 1; and Oasis, 11.

Amoseas currently has no wells in progress. Its latest test, I1 in Block 47, was abandoned recently at 5,395 ft.

Meanwhile, three Libyan concessions that were in blocks relinquished last year have been awarded to Phillips Petroleum and Pan American Libya Oil Co. (Indiana Standard).

Airlift Australia

AUSTRALIA'S Snowy Mountains Scheme has presented some unusual challenges to BP as sole supplier of petroleum products. Some of these challenges have been met in unusual ways, such as fuel drops from aircraft.

This gigantic project, midway between Sydney and Melbourne, with its great dams, power stations, and miles of tunnels and aqueducts, is designed both to provide hydro-electricity and to divert irrigation water westwards into the parched plains.

British Petroleum is proud to be associated with the Snowy Mountains Scheme, one of the world's greatest engineering undertakings.

BP

EXPLORATION SECTION

THE SEARCH FOR NATURAL GAS lies at the heart of nearly every exploration program in North America today. Consumer acceptance, freedom from proration, and ready capital for transmission and distribution combine to give a higher, faster return from gas than from crude oil.

But these are short-range factors. Danger signals, political ones, are hampering our present efforts to provide for future markets.

Federal regulation shows no sign of returning natural gas to a free-enterprise status. In fact, Washington's climate now leans toward a planned economy in end use of all fuels.

Cause and effect are linked inexorably. These long-range deterrents prevent the total effort for finding gas to a level far below that required to assure a ready supply of this fuel during the remainder of this century. The nature of the industry requires a 20-year lead on supply. We are not keeping pace with the needs of the 1980's today.

Against this background, the Journal presents this special section, devoted to a quest for a noble quarry . . . to the search for natural gas.

40 crucial

HOW WILL the natural-gas industry in the United States fare during the next 20 years? Using the past two decades as a gage, it should grow bigger and stronger.

Just how well has the industry progressed since 1940? Remarkable growth is evidenced by mounting reserves with each year setting a new mark and a consistent rise in marketed production of gas.

Only recently has gas become a prime drilling target rather than a dubious byproduct in the quest for crude oil. Soon we shall see pure gas exploration in new areas. There are many geological provinces that are considered excellent gas prospects.

There is strong sentiment in some quarters that the search for gas must be stepped up to meet the growing demand for it. Each year this energy source is becoming a more-wanted commodity. Curtailed drilling during the period from mid-1958 through the end of 1960 has resulted in shortening the effective life of domestic reserves.

The tempo will have to be picked up to keep a sound economic balance. For example, in 1941, the effective life of gas reserves was 40.5 years. At the end of 1960 the life of U. S. reserves had plunged to 20.3 years. More gas exploration is imperative to maintain a healthy economy. The situation will become precarious if this figure dips much below the magic figure of 20 years. Why 20? Almost all new pipeline construction is based on an amortization period of two decades.

Reserves are not climbing fast enough. In 1940, U. S. gas reserves were estimated at 85 trillion cubic feet. In the 20 years since, this figure has soared to 263.7 trillion cubic feet at the end of 1960. Reserves have increased at the average rate of 5.8% a year. But still, they have not kept pace with marketed production in keeping a comfortable margin.

During the same period from 1940 through 1960, marketed pro-

years for gas . . . *20 DOWN and 20 TO GO*

duction has increased at an average rate of 8¼% per year. In 1940, marketed production was 2.66 trillion cubic feet, while for 1960, it was 13 trillion cubic feet.

The question arises—are we finding new reserves fast enough to meet future demand? This can only be answered by determining what future demand may be.

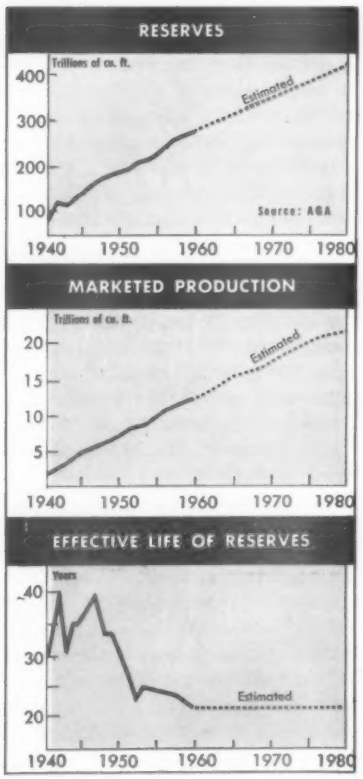
One thing is certain—demand is going up. It doesn't take a crystal ball to predict a bright future for this thriving industry—only the degree is indeterminate.

In short-range outlook, the future is brilliant. For a longer-range forecast, progression should be healthy, but the degree is speculative.

A report issued in 1958 by the Chase Manhattan Bank predicted a peak in natural-gas consumption about 1980. It was estimated that marketed production would be approximately 20 trillion cubic feet per year at that time. Yet this may be too conservative. One thing that has been learned about the gas industry is that revisions have to be made repeatedly because both reserves and demand are continually underestimated.

Fields that have produced for more than 40 years have had their life-expectancy span extended several times. Estimates of reserves for particular areas have been upgraded to new highs. Some areas are still too low according to their performance figures.

Another factor to consider—why is demand for natural gas on the rise? Not only are there undeveloped markets in much of the area now served with this energy for both power and heat, but a significant part of the country still has no gas available to it. In one large metropolitan area, it is estimated that more than 40,000 new connections could be made tomorrow if the supply were available. The population is continually increasing. With new families being formed as the postwar youngsters reach maturity, over-all consumption is bound to go up.



What does the future hold? The peak in reserves is anticipated around 1980. At that time by most conservative estimates, the total reserves are expected to be slightly more than 425 trillion cubic feet. Marketed production will reach 21 trillion cubic feet annually. It is noted in the accompanying charts that the effective life of reserves will stay above 20 years.

It is difficult to estimate the exact figure for two reasons. The short-term period between 1960 and 1970 is expected to increase volumetrically at a rate faster than normal and there might be some slacking off during the following decade from 1970 to 1980. Naturally, as the present potential gas areas which have been little explored continue to be developed, the large gas fields will become harder to find.

In all probability, the estimated figures shown for 1980 are conservative. The calculated rate of increase for both reserves and marketed production from 1960 to 1980 is 2.4% annual increase for each. This is less than half of the previous 20-year rate (1940-1960) for reserves and less than one third of the rate for marketed production over the same period.

Why the conservatism? Caution is the byword on any long-range gas projection. It has been cited that Chase predicts only 20 trillion cubic feet of marketed production in 1980. This is a safe assumption that, if improved upon, will be most gratifying. AGA concluded that reserves increased only 1.1 trillion cubic feet during 1960, despite the fact that 340 wildcat gas discoveries were made during the year. This is an average of only 3.24 billion cubic feet **per new area.**

A commonly accepted figure of 6 billion cubic feet per well is considered the minimum acceptable figure for a comemrcial gas field. In any study of gas wells producing 40 years or more, it is not uncommon to see performances of up to 50 billion cubic feet per well. Was 1960 gas exploration then a complete washout? According to AGA, it was. And **if** it was, then certainly the danger flag is up.

What happened? The primary search for gas is gaining momentum but is not fully under way yet. The gas that was found during 1960 was, for the most part, incident to crude-oil exploration. True, a few firms were seeking only gas, but they were in the minority. We cannot long pursue an exploration path that leads to gas bankruptcy.

The remedy lies in looking—looking for new **gas** reserves. And this means only one thing . . . drilling for gas and gas only, and more drilling. Drilling in new areas, and drilling in old ones. To fill our gas needs now known, and to meet those now unknown, every effort must be bent on **the search for natural gas.**

A distinguished panel of oil finders ponders a most unusual question . . .

THE PANEL
WALLACE E. PRATT
RALPH E. DAVIS
WARREN L. TAYLOR
GILMAN A. HILL
WARREN B. WEEKS
THEODORE A. LINK
KENNETH K. LANDES

What's the secret of successful gas search?

. . . Can we look for gas in preference to oil?

Wallace E. Pratt is a distinguished geologist and former vice president of Standard Oil Co. (N. J.). He is now a consultant in Carlsbad, N. M. His honors include Sidney Powers Medal (AAPG), Anthony F. Lucas Medal (AIME), and API Gold Medal for Distinguished Service. He is a past president and honorary member of AAPG.

"Guts."

Pratt: There's a difference . . .

IN RECENT YEARS, our rapidly spreading network of long-distance gas-transmission lines has so multiplied the demand for natural gas as to increase its market value nearer to parity, on a heat-unit basis, with oil. Is it likely, in view of this progressive change in our economy, that our future search will continue to be restricted to oil? May we not now come to search for gas as well as—or even instead of—oil? And if we do find ourselves engaged in an intensive search for gas, without regard to oil, how are we likely to modify our exploration techniques?

I submit that there are at least four fundamental differences between oil and gas which are of significance for those who would guide exploration for new reserves of natural gas:

1. Natural gas is compressible and, like all gases, it is subject (within limits) to the operation of Boyle's law, $PV = C$. Under the pressure normal to the rather moderate depth of 4,000 ft., a given quantity of gas occupies only 1% of the space it fills at atmospheric pressure. Oil is essentially incompressible and its volume is practically constant at all pressures.

2. Natural gas is a more mobile fluid than oil; at any given pressure it moves more readily, it moves more widely and it moves through smaller openings than oil does.

3. Natural gas is of much lower specific gravity than oil. Under the influence of gravity, in a confined space, gas floats on top of oil, just as oil floats on top of water.

4. Natural gas consists essentially of a single hydrocarbon, methane, and methane is the most stable of the hydrocarbons. We believe that methane is the earliest and most common hydrocarbon to form in the evolution of organic matter into petroleum; and we also believe that methane often remains intact after the normal processes of diastrophism have destroyed (or converted into methane?) all the other, less-stable hydrocarbons of petroleum. By contrast with the methane of natural gas, oil is an evanescent mixture of relatively unstable hydrocarbons.

From (1) we can deduce that, because of the increase of hydrostatic pressure with depth, a given reservoir at a depth of 10,000 ft. is capable of storing a much larger amount of energy in the form of natural gas than is the same reservoir at a depth of 2,000 ft. (roughly five times larger). Filled with oil, on the other hand, a given reservoir contains practically the same amount of energy whether it is 2,000 ft. or 10,000 ft. deep.

From (2) it follows that we can reasonably expect to find accumulations of natural gas from a given source rock more widely distributed, both laterally and vertically, than accumulations of oil from the same source. In this connection, of course, the vertical distribution of both oil and gas is limited by the normal decrease in porosity and in size of pore space in the rocks of the earth's crust, with depth.

In other words, we can reasonably expect to find commercially valuable accumulations of natural gas in reservoirs with such low porosity, or such small poresize that they would yield no oil into a wellbore.

The relationship defined in (3) assures to natural gas, moving together with its companion fluids, oil and salt water, through a porous member of a series of sedimentary rocks, first call on any structural trap it encounters. In such a potential reservoir, gas is buoyed up to the highest part, next to the impermeable roof. As it accumulates, gas replaces and expels down-

Why this panel discussion ?

THREE YEARS AGO, the Journal received the following letter from one of its readers:

"Dear Sir:

I have before me the volume entitled, 'How Oil Is Found.' This book is for the oil operator.

"I want to know if you have a book suited for the needs of the gas operator—in other words, 'How Gas Is Found.'"

We laughed. Anyone should know, we said, that the search for oil and gas is inseparable.

Things have changed in the last 3 years, and somehow when we reread this letter we are no longer inclined to laugh, but to credit the sender with a goodly bit of foresight. For in the past few years, more and more operators have set their sights for gas in preference to oil. And more and more, we've begun to wonder just how you do find gas!

Pursuing the question further, the Journal queried seven experts in the field of exploration. The men were asked this question:

"Can we evolve a philosophy or an approach to exploration for natural gas in preference to oil?"

Naturally we posed the question with a bit of temerity, fearing our experts would laugh at us in turn.

But they didn't. They surprised us with their positive approach. They didn't all agree, of course, but we find in their answers a certain tendency to answer "Yes" as a group, if not as individuals.

In these pages, the Journal would like to share with you these interesting conclusions drawn from some of the top exploration brains in the industry.

ward any oil or water that may have found its way into the trap. Driven out of their temporary refuge in this manner, these fluids spill out around the lower lip, or margin, of the trap and resume their migration through the porous member until they find another trap. In this way, if volume suffices, gas may fill completely one trap after another, to the total exclusion of oil.

So it is, we believe, that gas and oil from a single source often come to occupy different, widely separated, reservoirs.

The stable character of methane, the essential constituent of natural gas, as set out in (4), means that we may still reasonably expect to find commercial gas fields in large areas of rocks which are too highly indurated, or metamorphosed, to contain oil fields. It means, also, since metamorphism normally increases with depth, that we can expect to find gas at greater depths than oil usually occurs in the same locality.

We have set down some of the properties and characteristics shared by oil and natural gas, alike, which have enabled us in the past to discover all the gas we needed while concentrating our search upon oil. Similarly, we have set down some fundamental differences between oil and gas, the recognition of which may enhance the success of any attempt we are driven to make in the future to discover new gasfields where no oil is to be found.

In general we are justified in searching for natural gas wherever oil is known to occur. In addition, we can expect to find natural gas in areas of incipient metamorphism severe enough to have destroyed any accumulations of oil. We may also find natural-gas fields in reservoirs of lower porosity, or of finer pore space, than will yield oil into wells. Since normally, metamorphism increases and porosity decreases progressively with depth, we may find natural gas at greater depth than we could expect oil to occur in the same locality. Finally, we may reasonably hope to find natural gas in the central portions of deep basins in porous beds which produce oil only around the margins of the same basin.

An intensified search for natural gas should reward us with material additions to our proved reserves of natural gas. But a comprehensive search for natural gas will be expensive. It will take us into regions and it will carry our wells to depths where our chances of finding oil are nil. There will be little possibility of recovering part of our costs from an incidental discovery of oil. Such a venture will demand money, courage, fortitude and—I can think of no less inelegant word that is adequate—guts!

Ralph E. Davis, Houston, is consultant on natural gas and oil, specializing in reserves. In 1959, he received a citation of achievement in natural-gas industry from University of Wisconsin, his alma mater. He is to receive honorary membership in the AAPG at the meeting now in progress in Denver. Davis has often been called the "godfather of the natural-gas business."

"A goodly dose of horse sense."

Davis: I don't believe it's feasible

TO BE OF VALUE to this discussion, I must state the reasons for my views. Hence briefly I will say:

- We all want to find a lot of gas (and oil) of real economic worth; if not economic today, to become so within a reasonable time. What we really want is energy, and if we can find an economic way of recovering the energy in the enormous amount known, for example, in the petroliferous shales in California, we will meet our needs.
- Natural gas has always been found as easily as oil. The cradle of both—the Titusville area in Pennsylvania—brought oil, and then gas, and then the time came when gas was not only worthless and wasted, but considered a detriment. Those were the days when gasoline was worthless too, and much of it was destroyed. And soon kerosine had to go to China for a market of our surplus.

• Oil and gas have been produced in the United States for just more than 100 years. And the major problem of both oil and gas producers has been marketing; no shortage of oil except during World Wars I and II— and no real shortage of gas, except in a few places—right now.

• The discovery of oil and gas during the first 50 years was to a substantial degree the result of accident—or maybe luck. Geology had contributed but little, and seismic methods were unknown. As geology became useful, followed in the late 1920's by the first application of seismic methods and the never-ending improvement in drilling techniques, there followed the bonanza days of oil and gas discovery. The vast areas of prospective reserves required several decades of ever-increasing exploration to bring us to this day. Geological, seismic, and drilling techniques have developed into a very successful mastery of the problem of finding oil—and gas.

• Can we continue to be blind, and refuse to admit the truth? Our ability to find has exceeded our ability to handle what was found. In the United States, gas is increasingly hard to find, but we have the approach.

• As for how to look for gas, a great many people and many corporations have been doing just that—some men for a lifetime, corporations for even more than 50 years, e.g., Hope Natural Gas Co., South Penn, and many others. By exploring in a region known to be predominantly a gas region, their primary objective is gas.

If I were looking for oil, I would avoid Transylvania, although that country is very rich in natural gas. If I were looking for gas, I would avoid the oil shales of Colorado, although the Devonian shales in West Virginia and Kentucky are rich in gas and without oil. In an untested area, if drilling for hydrocarbons, we should look for both.

Fundamentally, I do not believe it feasible to separate the search for oil and gas except in places where previous exploration points the expectancy.

To find new gas, we should make use of the vast accumulated experience in applying geology, seismic surveys, drilling technique, including fracing, and if we have any, a goodly dose of "horse sense."

Taylor: It's possible and imperative

THE QUESTION concerns both the origin and occurrence of natural gas. Origin is necessarily a part of the problem whether it be stated or implied. But, to discuss the problems of source, migration, geothermal gradients, etc., is beyond the scope of the immediate question. Therefore, my comments are limited to geological and present economic considerations.

Natural gas occurs in all combinations of structural and stratigraphic traps; sandstone, limestone, dolomite, and even shale reservoirs; nonmarine to abyssal-type marine sediments; and in all periods of geologic time. The principal requisites for large gas reservoirs are obviously simple. A reservoir should be extensive, porous, and permeable, with sufficient rock pressures so that the reserves will justify projection of transmission facilities prior to development drilling.

"A breakthrough in cost of drilling."

Warren L. Taylor is manager of the geological and exploration department, El Paso Natural Gas Co. He is a graduate of Kansas State University, and the University of Illinois, where he took his master's degree in geology. He was with Phillips Petroleum Co. prior to his joining El Paso in 1949.

Most of the large, shallow domestic reserves found by surface, elementary subsurface, and cursory geophysical methods have been discovered. Exploratory efforts, whether directed toward finding oil or gas, now must be in the deeper and older, relatively unexplored portions of basins. Fortunately, this unexplored potential seems to be compatible with the occurrence of natural gas. The really large gas reserves found to date seem to be closely associated with areas which were stable during long periods of geologic time. These areas and periods are best represented in the Paleozoic era. Paleozoic rocks occur extensively in the deeper portions of many present-day structural basins which represent the great unexplored potential of many presently producing areas.

This is not to say that natural-gas reserves of considerable importance will not be found in rocks which do not meet some of the above qualifications. Surely, the search for reserves of limited magnitude has its place in any exploration program, and coordinating the present-day economics and long-range needs with the dictates of an organization's objectives is the explorationist's most difficult assignment. But, it is quite apparent that major gas fields (in excess of 1 trillion cubic feet of reserves) must be found to replace the large quantities of gas being consumed daily. It is this exploratory task with which we are vitally concerned.

The exploratory efforts of the future must be directed within basic economic limits and these limits are rigidly established. Natural gas can only be searched for and produced competitively with other energy sources. Although new mapping techniques provide excellent methods of delineating regional prospects and provide guides for more expensive and detailed exploratory methods, the stratigraphic information necessary to locate the large gas reserves of the future must be obtained by drilling the deep exploratory tests which are essential to supplying the necessary subsurface data. This immediately points up the explorationist's compelling need for a breakthrough in the cost of his most definite tool—exploratory drilling.

It is a fact that in less than two decades natural gas has progressed from an unwanted byproduct of the search for oil to a commodity which attracts the entire exploration budget of many and at least a portion of the exploratory budget of all. Certainly, it is now possible to direct a search for hydrocarbons where gas is the primary objective. To plan and control the search for gas within proper economic limits will require extreme flexibility in geologic evaluation of each individual basin or prospective area. This will necessitate an appraisal of the geologic conditions, drilling and development costs, and the deliverability of the reservoir over the life of the field, considering its distance from and the size of the available market.

"Geologic blotters."

Gilman A. Hill is president of Petroleum Research Corp., Denver. He is a graduate of University of Wisconsin and has done graduate research at Stanford University. Most of his career has been spent in research work. In 1959 he was a Distinguished Lecturer on tour for the AAPG.

Hill: Traps make a difference . . .

OBSERVATIONS of the major oil and gas fields of the world show that there are definite trends (1) in which mainly gas is produced, (2) in which mainly oil is produced, (3) in which both oil and gas are produced. Further observations show that the trends of gas production are frequently associated with nonmarine sediments, whereas the trends of oil production and the trends of both oil and gas production are more normally associated with marine sediments.

These observations can be substantiated (at least partially) by noting that agronomists find that most surface soils are preferentially oil wettable. When surface soils are buried as nonmarine sediments, they may retain much of their preferential wettability by oil. (Plans have been formulated to verify these findings further.) Therefore, when a mixture of oil and gas comes in contact with an oil-wettable fine-grained sediment, such as some nonmarine shales, the oil is imbibed by this "geologic blotter," and the gas is left in the permeable reservoir. Consequently, in areas where permeable reservoirs are associated with preferentially oil-wettable shales, every exploration program should be considered as primarily a gas-exploration effort.

In the preferentially water-wet sediments, such as most marine sediments, both oil and gas may be trapped in the reservoir rocks. However, the basic mechanisms of trapping and migration within the reservoir rocks often cause segregation of the oil and gas into distinct gas provinces and oil provinces. Also, specific types of traps are often selective for gas in preference to oil and vice versa. The application of these basic principles can successfully guide an exploration effort to find selectively either gas or oil accumulations.

In the early stages of migration and accumulation before any structural deformation has occurred, the primary trapping mechanism is normally some form of the stratigraphic or barrier trap. In these traps, the gas is in contact with the updip barrier because of gravity segregation. When migration has filled the trap to its trapping capacity, gas will begin to leak updip through the barrier to the next higher stratigraphic trap.

If this process were the only one that was effective, gas would be found predominantly in the farthest updip traps, and oil would be found in the farthest downdip traps. This pattern of oil and gas occurrence is commonly observed in stratigraphic traps. However, if regional dip is reversed or significantly changed during the geologic history of the area, this pattern may have several periods of readjustment.

When tectonic movement results in the formation of anticlinal structures, the gas or oil can be spilled out of the previous traps and be reaccumulated in the anticlines and also in reoriented stratigraphic traps. When an anticlinal trap is filled to its limiting structural closure, then additional accumulation will cause oil to leak under this spill point and migrate to other traps farther updip. In a few instances, this process leads to oil accumulation in the regionally updip structures and gas in the downdip structures. In many areas, however, the presence of stratigraphic-type-trap segregation of oil and gas is dominant over this structural-trap segregation of oil and gas.

Superimposed on these processes are the effects of hydrodynamic gradients. Hydrodynamic gradients are commonly present in most sedimentary sections (such as geologically very young or old sediments, high or low topographic relief, detrital or carbonate sediments, continuous or lenticular reservoirs, etc.).

Therefore, in the exploration for gas, it is necessary to investigate and correlate the relationships among structural closure, stratigraphic pinchouts, subcropping and onlapping of sediments, faulting, and the direction and magnitude of hydrodynamic gradients, in addition to the preferentially oil-wettable (oil blotter) or water-wettable characteristics of the shales and other fine-grained sediments.

Weeks: Yes . . . if there's incentive . . .

NO PROFOUND geological principles have been developed that tell us why gas is trapped in some locations, oil in others. Experience tells us we are more apt to find gas in certain geologic provinces, within certain

"Research and observation."

Warren B. Weeks has been manager of the land and geological department for Phillips Petroleum Co. since 1959. He is a graduate of University of Oklahoma, where he majored in geological engineering. He is a past vice president of the AAPG.

age zones or formations in some provinces, and within certain depth limitations in certain areas.

Phillips Petroleum Co. has a definite policy to concentrate domestic exploration largely in the search for natural gas rather than oil, although the total domestic exploration has been considerably reduced for the past few years.

As more fully described by C. M. Allen in another article in this issue, Phillips' experience indicates that our classification of exploratory expenditures (leasing, exploration, and exploratory drilling) as between oil and gas has been an accurate prediction of the actual results.

No doubt continued research and observation will shed more light on how and why gas or oil accumulates in reservoirs. Present studies on hydrodynamics may furnish a key. Certainly continued research on sedimentation and environment will help answer the problem.

A study of the exploratory wells drilled and operated by our company over the 13-year period ending with 1959 shows a 126% increase in cost per well. A look at all gas and gas-condensate wells (development and exploratory) completed during that period shows 144% increase in depth, 116% increase in cost per foot and 433% increase in cost per well.

In view of the international supply-and-demand picture, there is a serious doubt as to whether the price received for domestic crude oil will be adequate to finance the exploratory costs necessary to maintain adequate domestic oil reserves for national security in times of emergency.

Natural gas, on the other hand, is a very desirable and efficient fuel which cannot be easily or cheaply transported between continents. It can only be transported economically over land when it is backed by a huge reserve that will allow continuity of production and transportation over a long enough period of time to amortize original transportation and distribution costs.

The economic necessity that a huge reserve back up each cubic foot of gas sold requires large expenditures in exploration and development. This same requirement usually results in marketing delays which cause large exploration and development expenditures to be tied up and unproductive of a return on investment for a matter of years.

If the future demands for gas in the United States are to be met, the industry must greatly increase its exploratory effort. In addition it must focus the search on gas, and certainly the incentive for that search must lie in the price for gas.

If we assume that the prices for natural gas can be maintained on a fair and competitive basis to other fuels, the economic returns should be enough to finance the finding and development of reserves adequate to the needs of this continent until more desirable fuel sources are developed. In this event, we can expect the domestic exploratory effort to be continually more oriented toward the search for gas reserves.

If the sale of natural gas does not generate enough capital to finance exploration, it can be expected that necessary reserves will quickly fall to the point where even present demands cannot be met.

Theodore A. Link is consulting geologist, and president of Link, Downing & Cooke, Ltd., Calgary. He is a pioneer in Canadian exploration, and is credited with discovery of Norman Wells oil field for Imperial Oil Ltd. in 1920. He is past president of the Geological Association of Canada, and of the AAPG.

"Determine the physical principles."

Link: No . . . with qualifications

MY ANSWER to the question is "No" with qualifications. Not any more than we have, in the past, made use of a philosophy or an approach to explore for crude oil in preference to gas.

Since there is no clear-cut boundary between the gaseous and liquid hydrocarbons, one would find it difficult to set up an exploration program to search exclusively for natural gas. In western Canada and elsewhere, dry gas is found at shallow depths with or in close proximity to crude oil (i.e. laterally and vertically), and virtually dry as well as much wet gas is also found in the Plains area of relatively flat-lying sediments, as well as in the Foothills area of extremely severe tectonic disturbance.

One might assume that in view of the fact that

natural gas is a lighter substance than liquid petroleum, the former should be found at shallower depths than the latter, all other factors being the same. Unfortunately, other factors are usually to be reckoned with, and consequently such an empirical rule is of little value in dealing with large areas, whereas in specific isolated reservoirs that rule is employed.

Notwithstanding, in developing an exploration program, one can enhance his chances of finding gas, rather than oil, by following a few simple rules:

- Assemble and study all possible geological and engineering data in the area under consideration.
- Using statistical methods, map the areas where the incidence of gas discoveries is high in relation to oil and concentrate on exploration in those areas. (For instance, certain parts of the Plains area and a great deal of the Foothills of Alberta and British Columbia warrant special attention because of the high rate of gas discovery in these areas.)
- Where gas and oil pools exist separately in the same area and the same formation, determine the physical principles which cause the separation and by projection, search for more gas pools of this type. The theory of differential entrapment can be used to good advantage in some areas and some reservoirs in Alberta.

During the last 50 years many natural-gas discoveries were made incidentally to looking for oil. Many of those discovered were abandoned or ruined, many were never reported, and trillions of cubic feet of natural gas was wasted in producing the oil. There are some who call attention to a rather definite ratio between the crude oil and natural-gas reserves in a given area—or even world-wide. If such is indeed the case, one would expect more natural gas to be discovered in areas where recent discoveries of crude oil have been made, and also in areas where a minimum amount was wasted during the search for and production of crude oil. For example, western Canada should hold more promise for gas discovery than corresponding areas in the United States.

Landes: Coal is the bookkeeper

THERE ARE two locales where gas may occur without oil: (1) in semimetamorphic rocks adjoining mountain belts; and (2) in deep and relatively hot rocks.

The fixed carbon content ("carbon ratio") of coal, calculated on an ash-free basis, has proved to be an excellent guide to gas-without-oil in the Appalachian province where the fixed carbon increases from west to east. Since 1930, several dozen gas accumulations, mainly in the Oriskany-Devonian sandstone, have been discovered to the east of the oil fields in New York, Pennsylvania, Maryland, West Virginia, and Virginia.

The early proponents of carbon ratio formulated rules for oil and gas occurrence which were then applicable, such as "there is no oil beyond (east of) the 65% isocarb and no gas beyond the 70% isocarb." The subsequent discovery of gas beyond the 70% isocarb in no way invalidates the theory; it merely extends the boundary of the zone in which gas may occur. Indigenous oil is still very scarce beyond the 65% fixed carbon line.

Kenneth K. Landes is senior professor of geology at University of Michigan. He is a graduate of University of Washington and of Harvard, where he took his PhD. He is a past editor of the AAPG Bulletin, is the author of "Petroleum Geology," now in its second edition.

"Dig deep."

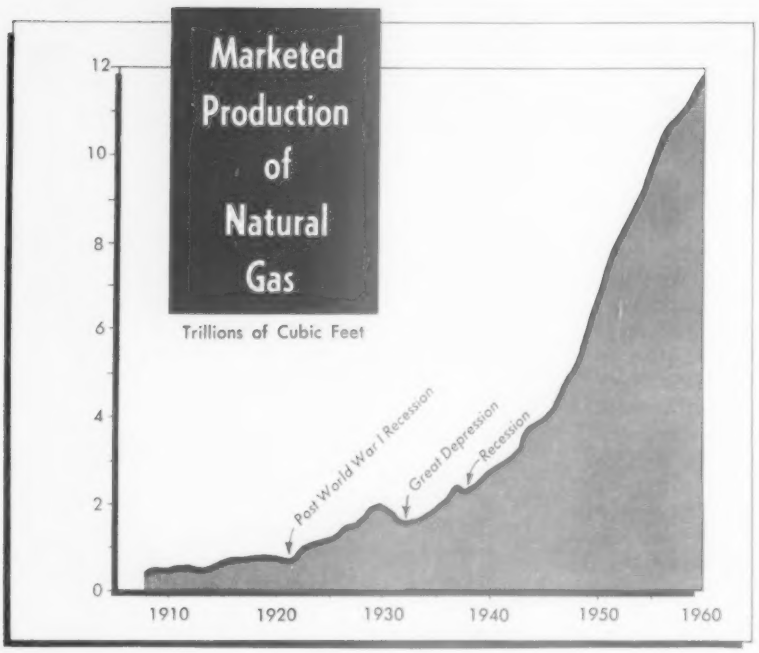
In spite of numerous attempts to illegitimatize the carbon ratio, the fact remains that in the Appalachian region there is a belt of semimetamorphosed rock, lying between unmetamorphosed sediments on the west and truly metamorphic rocks to the east, in which the petroleum hydrocarbons occur in predominantly gaseous form.

Another example of gas-only from semimetamorphic rocks is the Fort Smith district (Arkoma basin) of northwestern Arkansas and eastern Oklahoma. A third illustration appears to be shaping up in the Foothills belt of Alberta and British Columbia, where gas-only discoveries have been the rule as the mountain front is approached and the fixed carbon content of the Lower Cretaceous coals increases to a maximum of about 85%.

However, coal is merely the bookkeeper which records the **maximum** metamorphism in the geologic past. There can be zones of gas-bearing semimetamorphic rocks bordering diastrophic belts where coal is not present in the section; in this case the partially metamorphosed sediments are less easily identified as such.

We also know that in the deeper sedimentary basins the chances of finding gas only are much greater at the lower levels now being penetrated. In the latest list of producing depth record holders (OGJ, Jan. 30, 1961, p. 114) for different states or areas, 12 of the 15 wells producing from below 12,000 ft. are gas or condensate wells. The question is—are we entering a zone of semimetamorphic rocks comparable to the high-isocarb belts bordering diastrophically disturbed areas, or is the greater gasification of crude oil at depth due to greater temperatures and pressures? Or are they both the same thing, one in the past and one in the present? The petroleum chemists tell us that crude oil contains chlorophyll porphyrins which cannot endure temperatures above 200° C. (approximately 400° F.). It doesn't take much downward extrapolating of temperature increments beneath our deepest wells to determine that, if this thesis is correct, and since pressures probably do not alter the picture, liquid petroleum will disappear completely at depths between 25,000 and 35,000 ft.

The conclusion is that to find gas only, one should explore semimetamorphic belts which may be present fringing mountain areas, or dig deep where the basement is deep.



TODAY, the U.S. consumes 5½ times as much natural gas as it did 25 years ago. Fig. 1.

BY B. W. BEEBE

. . . president of Exploration, Inc., and petroleum exploration consultant, Boulder, Colo. He is a graduate of University of Wichita, and California Institute of Technology. He has had an outstanding career, having served in executive exploration positions with Shell Oil Co., British American Oil Producing Co., Bay Petroleum Corp., Anderson-Prichard Oil Corp., and Keating Drilling Co. He is now serving as special editor for the AAPG's forthcoming multivolume symposium on the occurrence of natural gas.

Natural gas *whooshes* from infant to giant in 25 years

"We in petroleum exploration must face facts, however unpalatable."

WHY has natural gas, an infant as recently as 1935, suddenly become a giant? "Upon what meat doth this our Caesar feed that he is grown so great?" Actually, few people realize the tremendous impact that natural gas has had upon our entire economy in a relatively few years.

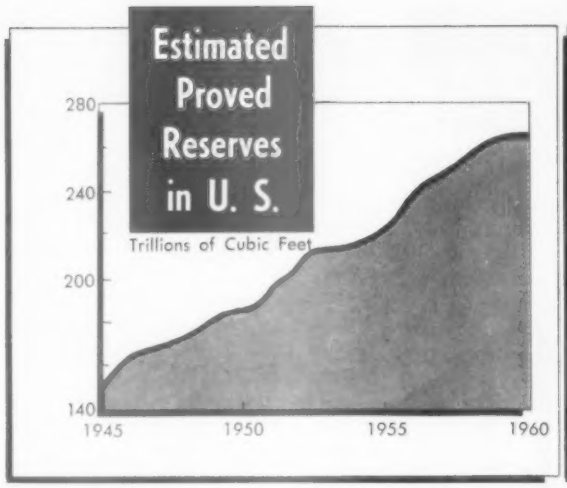
In 1935, the American Association of Petroleum Geologists published a symposium, "Geology of Natural Gas." At the time, it was the most complete, scientific treatise of its kind. It is indeed fitting that now, 25 years later, the association, in recognition of the greatness of gas, has in preparation a multivolume symposium, "Natural Gases of North America."

Suppose we were now producing an additional 7,081,000 bbl. of oil daily to increase our daily average production from the current 7,250,000 bbl. to a whopping total of over 14,280,000 bbl. daily. That is one measure of the impact of natural gas on the energy field and on the oil producer.

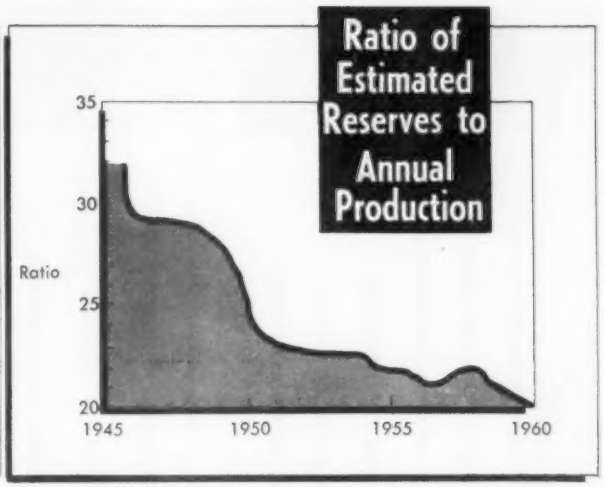
During 1960, 13 trillion cubic feet of natural gas was produced in the United States, equivalent on a B.t.u. basis to approximately 5,900,000 bbl. of oil daily. Of the total, about 11.89 trillion cubic feet reached the consumer, equivalent to almost 5,500,000 bbl. of oil per day. Add to this an average production of over 1,181,000 bbl. daily of natural-gas liquids during 1960, and the picture becomes crystal clear.

A comparison of the 1960 consumption of natural gas with that of 1946, when about 5 trillion cubic feet was marketed, reveals an increase of almost 2½ times in 15 years. Looking back to 1935, a quarter of a century, marketed production of natural gas was slightly less than 2 trillion cubic feet; an increase, then, of over 5½ times from 1935 through 1960. The rapid increase in consumption of natural gas is graphically portrayed in Fig. 1.

Total energy consumption in this country has more than doubled in



PROVED RESERVES of natural gas in the U. S. have grown steadily in the postwar years; in 1961, they stand at an all-time high of 263.7 trillion cubic feet. Fig. 2.



BUT CONSUMPTION of natural gas has grown so rapidly that the reserve-production ratio, in terms of year's supply, has plunged from 32 in 1946 to only 20.3 today. Fig. 3.

a quarter-century. Petroleum has garnered an ever-increasing percentage of this market at the expense of coal; but of the two components of petroleum (using the definition of the American Petroleum Institute), gas has outstripped oil.

Oil has not lost to natural gas. Natural gas is simply outstripping oil in competition for the major share of energy supply. We in petroleum exploration and production must face facts, no matter how unpalatable. We must fully realize the effects of shifting patterns of energy sources.

Consider this accelerating demand for energy in which oil and gas play such an important part. Energy is the ability to do work. The earliest sources of energy were muscle, either man or animal. These are inconsequential sources of energy today; but they afforded nearly 65% of all energy consumed in 1850. The nonrenewable fossil fuels, coal, oil, and gas, are now the sources of 95% of our energy. One-half of all the oil and gas used has been consumed in the past decade.

This tremendous growth in use of energy is a result of, first, population growth, and second, a rising standard of living with its increased per capita use of energy. Energy is required for four functions fundamental to our complex industrial civilization: (1) industry; (2) transportation; (3) space heating and cooling; (4) manufacturing of electricity, conversion of heat energy to electrical energy.

There are no indications, barring an international catastrophe, that our population will not continue to increase, nor that we will be forced to reduce our standard of living. Therefore, demand for energy will continue to increase.

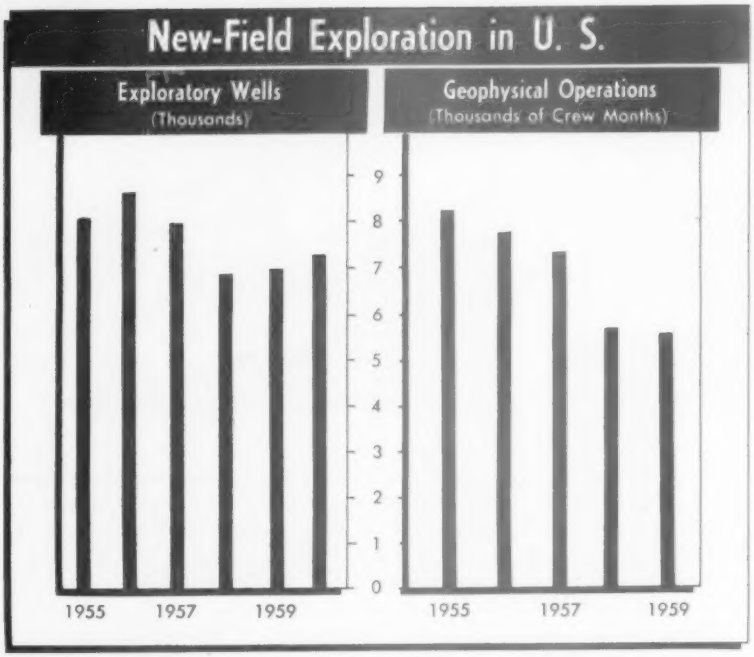
The golden age of pipeline construction occurred after World War II as a result of accelerated industrial activity and the consequent increase in energy requirements. Technological developments in gas transmission and subsequent increases in cost of coal as a source of energy contributed to this expansion. However, the greatest single factor is that gas has been and is grossly underpriced as a source of energy when compared to both coal and oil. Gas is a premium source of energy, low in price, safe, clean, dependable, and convenient.

Technology has brought together the two basic fundamentals: a sufficient and suitable gas supply, and a sufficient market so now all major centers of population and industry are connected to sources of natural gas.

In the past, natural gas was shamefully wasted for lack of market. Of all sources of energy, natural gas is the most sensitive to the availability of transportation facilities, and is worthless without them. Because of its physical character, movement of gas has always been completely dependent on one type of transportation: a pipeline.

According to the American Gas Association, proved natural-gas reserves stand at an all-time high in 1961 of 263.7 trillion cubic feet, an increase of 103.1 trillion cubic feet over 1946. Yearly increase in reserves is shown from 1946 through 1960 in Fig. 2. However, consumption has increased to the point that proved reserves which in 1946 amounted to 32 times the annual rate of consumption now represent only slightly more than 20 times the present rate of consumption. The reserve-production ratio from 1946 through 1960 is demonstrated graphically by Fig. 3.

The figures, so commonly used to represent a large gas supply, more than 20 years at current rates of consumption, contain an inherent fallacy. If no more reserves were added, deliveries could not be maintained at the present rate, but would diminish continuously. The amount of gas that can be withdrawn in any one year is not a function of demand, but rather a function of the ability of each individual reservoir or even each well to deliver gas to the pipeline. Engineers have estimated that current consumption could be delivered for no more than about 14 years from present reserves, after which deliveries would diminish. It is estimated that demand will increase substantially for the next few years. To supply this estimated increase in demand, it has been estimated that we must find an average of 23 trillion cubic feet of gas per year, but the annual average discovery rate for the past 15 years has been only about 16.6



DECLINING EFFORT in new-field exploration and seismic activity reflects a shrinking number of new prospects in the U. S. Today's wildcats are being drilled on prospects that were discovered years ago. Fig. 4.

trillion cubic feet. In 1960, according to AGA, our proved reserves grew by only 1.1 trillion cubic feet.

The greatest source of new reserves is always from extensions of and revisions of estimates made on fields found in past years. And bear in mind that discovery rates and reserves depend directly on the number of exploratory and development wells drilled, which in turn is tied to exploratory activity (hunting) of preceding years. Since oil and gas are interdependent, a review of exploration and drilling over the past 6 years, as depicted in Fig. 4, is startling. Today's wildcats and discoveries are being drilled on prospects defined several years ago, and as hunting for prospects diminishes, it is inevitable that wildcatting and resultant discoveries must decline.

Various authorities have estimated total gas reserves of the United States at from 750 to 1,700 trillion cubic feet. Several methods have been used, all of them intriguing. They are exercises in mathematical skill; extrapolation and ingenuity based on several assumptions, all or any of which could be in error, and are fundamentally meaningless in terms of availability of natural gas. These so-called reserves are mere possibilities. They do not tell us where the gas is to be found, the depths at which it may occur, whether or not it can be profitably produced, or whether it will ever be found.

The real problems therefore are how much gas may be present in nature, what volumes are we finding, and what efforts are we making to increase our supply? The availability of this gas to the consumer is a function of exploration and discovery, which are sensitive to several important factors, Although it has been stated correctly by government officials that the amount of gas remaining to be discovered is "fixed ultimately by nature," the necessary **rate** of discovery, or indeed any discovery at all, depends on the rate of exploration activity, which in turn depends **completely** on economic factors: the price of the product and availability of market.

There is no doubt that our potential gas reserves are extensive. It is estimated that 500 trillion cubic feet of them has been found to date, but they are a wasting asset destroyed in their use, and are finite in quantity. They are not being replenished for our use; each new province opened is one fewer to be explored; each new field discovered is one fewer to be found. As a general rule, the easy and obvious are found first—we are long past that stage. Successful exploration for gas and oil becomes increasingly difficult and costly, and this trend will continue with rising costs and diminishing annual discoveries in time. Reserves per discovery are already diminishing, and necessary deeper drilling results in sharply increased costs. The domestic oil industry is faced with this situation even now, virtually "pricing itself out of the market."

The four largest reserves of gas in the U. S. are: Panhandle-Hugoton (70 trillion cubic feet ultimate), San Juan (15 trillion), Jalmat-Eumont (8.1 trillion), and Monroe (6 trillion).

No single reserve comparable to the four largest has been found since the discovery of Carthage in 1936, nor has any such major reserve been found at depths of less than 6,000 ft. since 1936. Out of 205 producing reservoirs below 11,000 in the Texas - Louisiana Gulf Coast, counted in 1958, 139 or more than two-thirds, are of the gas-condensate type.

Although the magnitude of gas reserves remaining to be discovered is no doubt immense, the tremendous increase in demand, coupled with the fact that **rate** of discovery cannot be controlled, suggests caution. The consumer of natural gas is the ultimate victim of the inability of the industry to furnish sufficient supplies at the necessary rate.

Gas Habitats

Natural gases are found in all petroliferous provinces in North America in varying quantities. Commercial quantities of gas have been found in 30 states, and 8 provinces and territories in Canada. The bulk of the reserves in the United States is in 21 states, but only 7 of these are of real importance.

The greatest volumes of gas found to date in the Paleozoic rocks of the Appalachian area and the interior United States in the Tertiary and Mesozoic rocks of the Gulf Coast embayment, Tertiary rocks of California, and in the Mesozoic strata of the intermountain basins of the Rocky Mountain area.

No doubt there will be continued substantial additional discoveries in

the Paleozoic basins, particularly the Delaware basin of West Texas and New Mexico, the Val Verde basin of West Texas, the Anadarko basin of Texas, Oklahoma, and Kansas, the Arkoma basin and the Ouachita Mountains of Arkansas and Oklahoma, the Michigan basin, deeper beds and stratigraphic traps of the Appalachian geosyncline, and perhaps the Palo Duro basin of Texas and the Warrior basin of Mississippi and Alabama. Nevertheless, it appears that major reserves of the future will be found in other areas and younger strata.

The Tertiary of the Gulf Coast embayment and particularly the offshore areas appear to have the brightest future: recent discoveries in Lower Tertiary and Upper Cretaceous strata of the Piceance, Sand Wash, Uinta, Green River, and Wind River intermountain basins have been of significance during the past few years. Several most interesting intermountain basins remain to be adequately explored.

And what of Alaska, the forty-ninth state, boasting a recent, apparently important gas discovery on the Kenai Peninsula? Oil and gas potential of this frontier is most promising. However, distance, physical obstacles, and climatic conditions retard exploration. Furthermore, from the standpoint of natural gas, distance and costs of construction are very real problems in bringing gas to market within the 48 mainland states in the foreseeable future.

Although gas reserves and future potential in both Mexico and Canada are extensive and promising, nevertheless, demand for energy is increasing rapidly in both countries as their standard of living improves and industrial capacity increases, and both are historically loath to export this premium source of energy. Thus it appears that most of our future demand must be satisfied within our own borders.

And who bears the responsibility for satisfying these requirements? Those of us in exploration are faced with an unprecedented challenge. The geology of oil and natural gas is essentially the same. Oil and gas often occur together, are found in the same type of traps, and under the same geologic conditions. However, there are some areas and some sedimentary deposits which appear to be primarily gas bearing, containing oil in only minor quantities. On the other hand, there are certain areas in which oil predominates, and where gas in commercial quantities is the exception. Furthermore, as discoveries are found at greater depths, gas and condensate appear to predominate. The forthcoming symposium will cast additional light on these problems.

Approach to Discovery

The exploration for both gas and oil, as well as the application of geologic principles to the problem of locating deposits of hydrocarbons, is also similar in most respects; the same methods and techniques are used. In most petroliferous provinces it is virtually impossible to determine in advance of the drill whether gas, oil, both, or nothing will be discovered. You will read some interesting opinions on this matter in the preceding article.

However, there are certain fundamental differences which must be thoroughly understood before exploration for gas can be economically successful. When oil is discovered in this country, even though remote from pipeline outlets, its physical character is such that it usually can be transported by other means. The operator may be penalized by additional transportation costs, but he can be reasonably certain of selling his product in some quantity almost immediately on completion of a well. **This is not the case with natural gas.**

The peculiar and unique physical characteristics of natural gas require transportation by pipeline. If a gas discovery is distant from a pipeline, years of effort, coupled with expenditure of millions of dollars, may be required to develop sufficient reserves for a market.

A discovery with a reserve of 1 million barrels has been accepted by the oil industry in this country as a generally profitable venture. An average barrel of oil is equivalent to 6,000 cu. ft. of gas on B.t.u. basis. Hence a reserve of 1 million barrels of oil is often compared with a reserve of 6 billion cubic feet of gas.

Unfortunately, the operator who discovers an oil field with a reserve of 1 million barrels of oil is in a preferred position over the operator who discovers 6 billion cubic feet of gas. Unless the gas discovery is close to a pipeline, he may wait years if he ever secures a connection. If he is distant from a transmission line, no matter how large the discovery, he may be forced to spend millions of dollars developing reserves, having to shut in his wells before a transmission line is willing to offer a contract, and before the Federal Power Commission will authorize connecting the wells. Nor can he make any reliable estimates of the price the commission will finally approve.

A rule of thumb often used in the industry is that, where major construction to distant discoveries is contemplated, **10 billion cubic feet of reserves** is necessary for each mile of new line construction. Obviously this is only a generality, for costs vary vastly with distance, size of line, and physical obstacles to construction. One hundred miles might require expenditures to develop 1 trillion cubic feet of reserves before a line is built. Assuming 10 billion cubic feet reserve per well, with an average well cost of $100,000, an expenditure of 10 million dollars might be required to secure a market.

It is virtually impossible to make conventional loans on shut-in gas wells, and few independent operators could ever consider such an expenditure. The interest factor alone on buried capital may make it impossible to recover an investment, even though there is an eventual market. Potential reserves of billions or even trillions of cubic feet of gas may be uneconomic because of factors of time and distance.

Gas wells are similar to oil wells in that many of them never return the investment, even with an adequate market. According to statisticians, only 1 oil discovery in 49 is economic, and an even higher ratio undoubtedly applies to gas.

"... only operators with huge resources will be able to explore for gas."

The oil operator is more fortunate in that prices of oil are such that he can make a fair estimate of return per barrel sold. Gas is sold on long-term contracts at fixed prices regulated by the Federal Power Commission. Gas from offsetting leases in the same field has been sold at vastly different prices, and there are even cases where gas from the same well, owned by different operators, sells at different prices! Furthermore, the Federal Power Commission frowns on "favored nation" and escalation clauses.

Until recently, regulation of natural-gas prices and operations by FPC injected grave elements of doubt into the marketing of natural gas. An operator who had developed substantial reserves and negotiated a favorable long-term contract with a purchaser faced the possibility of having the price reduced by the commission, or of being forced into long and expensive hearings to attempt to justify a return at which he could afford to explore for and develop gas production. Too frequently all the cost factors either were not or could not be determined.

However, on September 28, 1959, FPC made a most constructive move. The commission established an "area pricing" policy, prices by geographic provinces in the productive sectors of the United States by which new sales of gas will be regulated. Thus, producers can plan ahead with some certainty and a method for eliminating controversy over new sales of gas, so long as they do not exceed area prices, appears to have evolved.

This does not mean that all of the producer's problems with regulation by FPC are solved. Nevertheless, if the policy remains in effect many uncertainties will be eliminated, and making of firm contracts and connections will be facilitated. The effect of the new policy will be to encourage exploration and development, yet afford protection to the consumer against uncontrolled upward revisions in rates for gas now under contract. Unfortunately the indicated unfavorable attitude of the new administration could very well negate this progress.

The percentage of return on gas sales to the operator is considerably less than the return from oil. In the past, profits from oil discovery and production have actually subsidized exploration for the production of gas.

All of these factors contribute to conditions so that the small independent operator who has been so important in the development of the domestic oil industry simply cannot afford to take these risks above and beyond normal risks of operation.

Thus the situation can develop to the point where only operators with huge financial resources will be able to economically explore for and develop gas reserves, an unfortunate situation which in the long run can lead to virtual monopoly in production of natural gas.

Geology vs. economics. Obviously there is a fertile field for application of geologic principles in the natural-gas industry, primarily in exploration. Huge potential gas-producing regions await adequate and conclusive exploration. However, exploration and exploitation of most of them will not be rapid. Many of them are remote from adequate market facilities. The presence of huge quantities of natural gas in the San Juan basin was well known as early as 1930, but it was not until El Paso Natural Gas Co. laid a transmission line to Needles, Calif., in 1954, that these supplies were available to a large market, and operators could anticipate a fair return on their investment. Meanwhile, millions of dollars were spent for development with little return.

In many instances, profits from oil production in other areas made it possible to continue to develop gas reserves in spite of the meager returns. However, oil can no longer support the search for natural gas. The natural-gas producer cannot secure capital to develop gas reserves without adequate economic incentives in the form of a fair price for his product.

Geologic and other economic complications are of even greater importance. Most of the obvious traps in which oil and gas may accumulate in this country have been tested. Provinces remaining to be explored and developed are areas of complex, obscure geological conditions. The Disturbed belt at the eastern edge of the northern Rocky Mountains, and the Ouachita Mountains are prime examples of structurally complicated areas which often defy conventional methods of exploration. The unusually complex facies and stratigraphic conditions in the Tertiary and Upper Cretaceous of the intermountain basins of the Rocky Mountains present major problems.

Cost and expense of exploration, leasing, exploratory and development dry holes is the principal expenditure in proving reserves of hydrocarbons. There can be only one conclusion: Expenditures for exploration and exploratory dry holes drilled preceding each discovery will increase continuously. Rates and reserves per discovery will diminish continuously, and more dry holes will be drilled in exploiting new discoveries. Finally, depth of new discoveries is constantly increasing, with astronomical increases in costs of drilling and development. For example, costs of drilling at depths below 15,000 ft. often exceed $100 per foot! All of these factors simply add up to one indisputable fact: each cubic foot of gas discovered in the future must bear its share of ever-increasing costs of exploration, discovery, and development.

The geologist with natural gas as an exploration objective not only faces problems and hazards inherent to all exploration, but is beset by a series of confusing and contradictory economic conditions which often well nigh defy reasonable estimates. There is no doubt that there are many areas in which to explore for our future needs of natural gas. However, the rate of discovery, and in truth, whether or not many of these potential reserves are ever available to the consumer, is a matter of elementary economics. Adequate economic incentives, encouragement by an adequate return on risk and investment through ample market and price, are mandatory if operators are to continue to search for and wrest these elusive deposits of natural gas from Mother Earth.

Depth makes a difference in the search for Natural Gas

. . . as incentives shift from oil

C. M. ALLEN
Staff Geologist for Gas
Phillips Petroleum Co.

IT IS COMMON knowledge, and a matter of much concern, that the world oversupply of oil has put the business of searching for and producing oil in the United States into the doldrums. Since 1954, in all states in which the production of oil is prorated to market demand, the per well allowables have declined sharply. The result has been to restrict oil revenues drastically and, in the major producing states, funds available for exploration have declined, and the incentive to look for oil as such has been greatly curtailed.

Although the trend of the total search for oil and gas has been downward since 1956 and continues to be downward, the initial prices which the pipeline companies are now offering for gas have had the effect in many areas of tending to arrest the downward trend in the search for gas and of focusing the search on gas.

A look at the American Gas Association forecast of demand indicates a tremendous job needs to be done by producers in order to supply that future demand. A simple calculation shows that for the 10-year period beginning in 1960, if a reserves-production ratio of 20 to 1 is to be maintained, the industry must add an average of 26 trillion cubic feet each year. The enormous exploratory and development effort which is needed to accomplish such a task is indicated by these facts:

- Gross reserves added have never been as much as 26 trillion cubic feet in any year.
- The average during the 10-year period ending 1959 was 17.9 trillion.
- The gross reserves added during 1960 were only about 14 trillion, which, except for 1954, was the lowest addition in the last 10 years.

Phillips' management has become intensely interested in knowing as nearly as possible the objectives of its exploratory program as between gas and oil. As a result, since January 1, 1959, all of Phillips' direct exploratory expenditures have been classified into two broad categories—gas, including gas-condensate, on the one hand and oil on the other. The classification into which the expenditure falls is dependent upon the primary objective of that particular exploration. In other words, before the expenditure is made, the following question must be answered: "If we find any production at all as a result of this expenditure, what will the production most likely be?"

We have found that below certain depths in some areas and at all depths in other areas, the productive reservoirs which have been found are predominantly gas and gas-condensate reservoirs. For example, below 8,000 ft. in the Gulf Coast, more than half of the producing reservoirs are gas and gas-condensate; below 12,000 ft., approximately 7 out of every 10 producing reservoirs are gas and gas-condensate. In Pennsylvania and West Virginia, gas reservoirs predominate below 5,000 ft. In eastern Ohio, from the Clinton formation on down, gas again predominates. In other areas, such as the Green River—Red Desert basin, the Anadarko basin, and the Arkoma basin, gas and gas-condensate reservoirs predominate at all depths. Obviously in areas such as these, the primary objective of nearly all of our exploratory expenditures must be for gas. In other less well-defined areas, a careful study of trends, nearby production, and experience must be made in order to answer the question as to what is our primary objective.

Of course, the validity of this approach to the matter of exploration for gas as such or exploration for oil as such can only be tested by the results. By the very nature of the business, many exploratory expenditures result in finding no production; the results of other expenditures are not evident until some time in the future, perhaps several years. However, a check of all prospects in respect to which the actual results could be determined shows a very close correlation between the original classification and the actual results. The objectivity of the approach is further strengthened by the fact that where results have differed from original classifications, the direction of error has been almost equally balanced as between oil and gas.

Phillips has found through this procedure that in 1959, more than 50% of its exploratory expenditures were made in the search for gas reservoirs. Preliminary figures for 1960 indicate a considerably higher percentage to gas.

Natural gas recognizes no barriers

. . . It's everywhere, in sand or lime, deep or shallow, on every continent, as the accompanying tabulations reveal

THE UBIQUITY of natural gas is amply demonstrated on these pages. This survey of gas occurrence was undertaken to see if, from it, we could reach any major conclusions that might serve as guideposts to future explorers.

The Journal presents the first tabulation of gas reserves of 147 principal gas fields. These tables list the world's 57 major gas areas . . . those with an estimated ultimate recovery of 1 trillion cubic feet or more, and (by basin habitat), the 90 principal gas fields of North America . . . those with a cumulative production of 100 billion cubic feet or more.

The Majors

Of total U. S. gas reserves (262.6 trillion cubic feet as of January 1, 1960)*, 44.3% lies in its 47 major fields. Of total U. S. gas production through 1959 (170.8 trillion cubic feet), 54.8% came from these fields. Ultimate recovery of all fields in the major table is 275.65 trillion cubic feet, cumulative production is 95.906 trillion cubic feet, and 179.744 trillion cubic feet remains. The number of producing gas wells in the majors, world-wide, is 63,948.

U. S. major fields—
- 209.75 trillion cubic feet ultimate recovery
- 93.545 trillion cubic feet produced
- 116.205 trillion cubic feet remaining reserves
- 63,416 producing gas wells

Foreign major fields—
- 65.90 trillion cubic feet ultimate recovery
- 2.361 trillion cubic feet produced
- 63.539 trillion cubic feet remaining reserves
- 532 producing gas wells

*Latest reserve estimates by American Gas Association as of January 1, 1961 (OGJ, March 27, 1961, p. 66) were not available for this survey, but net increase was only 1.1 trillion cubic feet during 1960.

Gas factors. In the major gas fields of the world, 214 trillion cubic feet of gas has been found in fields with depths above 10,000 ft. . . . the rest from fields producing below 10,000 ft. Thus, as it stands now, depth seemingly has little effect on gas occurrence.

Gas production from the various types of rock — sandstone, limestone, dolomite — is about evenly split between sand and lime. Thus, lithology seems to have no effect on gas habitat.

Concerning ultimate reserves, about 77 trillion cubic feet of gas lies in rocks of Permian age, 35.3 from Triassic. Mesozoic rocks account for about 85 trillion cubic feet, Paleozoic 122.8 trillion, Cenozoic 58.9 trillion. Gas is produced from all but Cambrian rocks.

The Mid-Continent province is the biggest reservoir of gas with 104.2 trillion cubic feet. Foreign fields account for about 56 trillion, the Rockies 15 trillion, Gulf Coast 46 trillion, and Appalachians 26.6 trillion.

Geologic environment, therefore, seems to be the only real factor governing gas accumulation. The biggest gas reserves of the world are in the Panhandle-Hugoton, Algerian, San Juan, French, and Appalachian areas. Gulf Coast fields, with all their prolific and multipay reservoirs, still account for only about 46 trillion cubic feet. Of the 10 top gas reserves in the world, 2 lie overseas, 3 in the Mid-Continent, 1 in the Rockies, 2 in the Appalachians, 1 in the East Texas basin, and 1 in West Texas.

Principal Fields

Ultimate recovery of fields in this list is 41.6 trillion cubic feet in North America. Production from these 90 fields has reached 18.8 trillion cubic feet, and 22.8 trillion cubic feet remains in reserve. There are 4,190 wells producing gas in these North American fields.

In Canada and Mexico ultimate recovery of fields is 1.8 trillion cubic feet; .8 trillion cubic feet has been produced, and 1 trillion cubic feet remains. There are 235 wells in the foreign fields on the North American Continent. In the U. S. alone, 39.8 trillion cubic feet lies in the ultimate column, 17.9 trillion cubic feet has been produced, and 21.9 trillion cubic feet remains. There are 3,955 wells producing in the principal U. S. fields listed on the table.

The principal gas-field table accounts for about 8½% of all remaining U. S. gas reserves, while the major table shows 44.3% of all remaining U. S. gas.

The New Ones

No fields as big as Panhandle-Hugoton have been opened in the past decade, but 15 of the 57 majors have come onto the scene since 1950. Hassi R'Mel in Algeria, the world's No. 2 gas area, is only 5 years old.

There were 13 major gas fields opened during the 1940's, 15 in the 1930's, leaving only 14 opened in the years 1870-1930. While the number of huge new oil reserves in the world seems to dwindle from year to year, the number of new gas reserves of great size keeps growing. It has been said that in order to meet estimated required production rate of 15 trillion cubic feet by 1965 and to maintain a minimum 20-year life index, we must find from 1956-1965 about 23 trillion cubic feet per year. In 1957 we added only 20 trillion, only 19 trillion in

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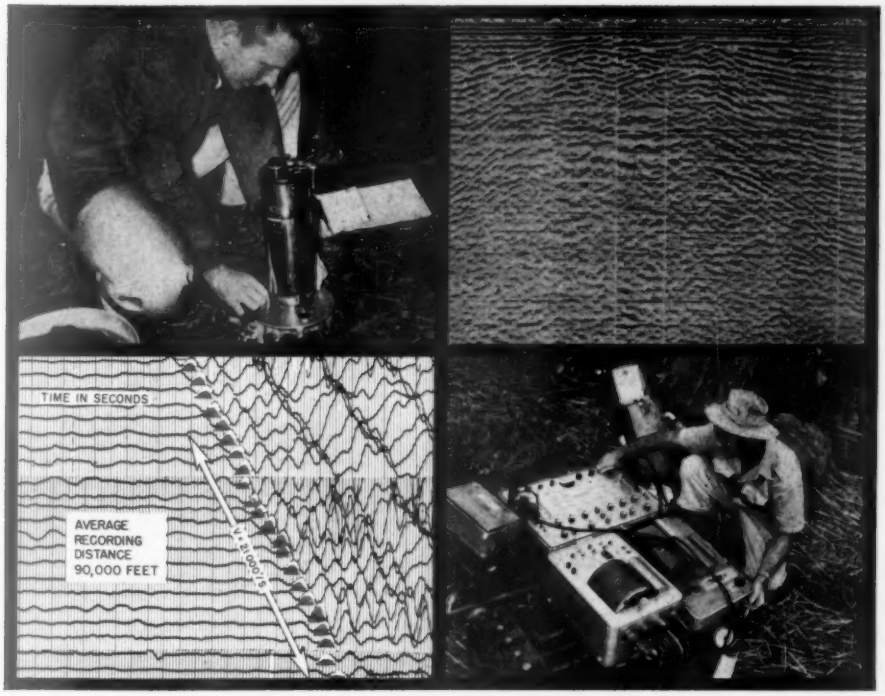

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Major gas areas of the world

Ultimate recovery of trillion cubic feet or more

Rank	Field	Location	Year discovered	In trillions of cubic feet—Original reserve	Cumulative prod. 1-1-60	Est. remaining reserve	Productive gas wells drilled 1-1-60	Producing formation—Age	Avg. depth (ft.)
1.	Panhandle-Hugoton	Kans.-Okla.-Tex.	1918	70.0	33.0	37.0	7,783	Permian	1,400- 3,800
2.	Hassi R'Mel	Algeria	1956	35.3	0.0	35.3	9 (S.I.)	Triassic	6,880
3.	San Juan (all fields)	New Mex.-Colorado	1927	15.0	1.8	13.2	4,260	Cretaceous	5,500
4.	Lacq	France	1951	14.0	0.07	13.93	35	Cretaceous	12,000
5.	West Virginia field	West Virginia	1880	11.4	10.0	1.4	15,800	Silurian-Devonian	1,300- 7,000
6.	Pennsylvania field	Pennsylvania	1870	8.35	7.3	1.05	16,500	Silurian-Devonian	1,500- 7,000
7.	*Jalmat-Eumont	New Mexico	1927	8.1	4.1	4.0	791	Permian	3,700
8.	†Puckett	West Texas	1952	6.5	0.3	6.2	40	Permian, Devonian, Ordovician	10,000-15,000
9.	Monroe	North Louisiana	1916	6.0	5.7	0.3	2,044	Cretaceous	2,150
10.	Carthage	East Texas	1936	6.0	4.0	2.0	720	Cretaceous	4,700- 6,400
11.	Katy	Texas Coast	1935	6.0	0.5	5.5	40	Eocene	6,250- 7,450
12.	*Old Ocean	Texas Coast	1934	5.0	1.0	4.0	35	Oligocene	10,500
13.	Sui	West Pakistan	1952	4.0	0.05	3.95	4	Eocene	4,000 (?)
14.	Rio Vista	California	1936	3.5	2.0	1.5	150	Eocene	3,700- 5,000
15.	Ohio field	Ohio	1870	3.7	3.0	0.7	6,900	Devonian-Silurian	1,000- 4,000
16.	*Rodessa	Ark.-La.-Tex.	1930	3.2	1.9	1.3	123	Cretaceous	5,400- 7,800
17.	Kentucky field	Kentucky	1883	3.1	2.0	1.1	4,500	Penn. through Ord.	1,000- 4,000
18.	*Greta-Tom O'Connor	South Texas	1933	3.0	0.8	2.2	225	Miocene-Oligocene	1,700- 5,700
19.	*La Gloria	South Texas	1939	2.9	1.5	1.4	53	Oligocene	5,200- 9,800
20.	Big Piney	Wyoming	1922	2.8	0.144	2.656	160	Cretaceous-Tertiary	900- 9,000
21.	Peace River Region	British Columbia	1943	2.5	0.141	2.359	193	Triassic, Cret., Permian, Penn., Miss.	2,100-11,000
22.	*Chocolate Bayou	West Texas	1952	2.5	0.2	2.3	57	Oligocene	9,600-12,800
23.	Bethany-Waskom-Greenwood	E. Tex.-No. La.	1916	2.5	1.4	1.1	465	Cretaceous	1,000- 6,000
24.	Gwinville	Mississippi	1944	2.5	0.9	1.6	80	Cretaceous	8,000
25.	*Stratton	South Texas	1937	2.5	1.4	1.1	106	Oligocene	4,900- 7,300
26.	Laverne-Mocane	Oklahoma	1952	2.2	0.2	2.0	340	Permian, Pennsylvanian, Mississippian	3,100- 7,600
27.	*Bateman Lake	South Louisiana	1937	2.0	0.14	1.86	12	Miocene	8,600-12,800
28.	*Bastian Bay	South Louisiana	1941	2.0	0.02	1.98	24	Miocene	4,300-14,500
29.	*Agua Dulce	South Texas	1928	2.0	1.6	0.4	173	Oligocene	1,900- 7,100
30.	Slochteren-Delfzjil	Holland	1959	2.0	0.0	2.0	3	Zechstein (Permian)	9,500
31.	*Turner Valley	Alberta	1924	2.0	1.8	0.2	96	Mississippian	3,800- 8,300
32.	*Eugene Isle Blk. 32	Offshore Louisiana	1949	2.0	0.3	1.7	7	Miocene	7,500-10,750
33.	Brown-Bassett	West Texas	1957	1.9	0.001	1.899	12	Pennsylvanian, Silurian, Ordovician	11,500-13,800
34.	Pincher Creek	Alberta	1948	1.8	0.07	1.73	12	Mississippian	11,750
35.	Waterton Park	Alberta	1957	1.6	0.0	1.6	13	Mississippian-Devonian	10,350-13,000
36.	*Erath	South Louisiana	1940	1.5	0.3	1.2	90	Miocene	7,000-13,000
37.	Medicine Hat	Alberta	1904	1.5	0.23	1.27	160	Cretaceous	1,400- 2,400
38.	*Duck Lake	South Louisiana	1949	1.5	0.4	1.1	75	Miocene	12,800
39.	*Sligo	North Louisiana	1922	1.4	1.1	0.3	194	Cretaceous	830- 5,600
40.	Long Lake	East Texas	1933	1.4	0.75	0.65	31	Cretaceous	5,200- 5,400
41.	*Cranfield	Mississippi	1943	1.4	0.5	0.9	104	Eocene-Cretaceous	4,000-11,600
42.	Joaquin-Logansport	East Texas	1936	1.3	0.6	0.7	74	Cretaceous	1,200- 3,600
43.	Vermilion-Blk. 39	Offshore Louisiana	1949	1.2	0.3	0.9	18	Miocene	7,500- 9,400
44.	Tulsita	South Texas	1945	1.2	0.35	0.85	21	Eocene	6,800- 7,700
45.	South Westerose	Alberta	1953	1.2	0.0	1.2	7	Devonian	7,500
46.	Deep Lake	South Louisiana	1952	1.1	0.2	0.9	58	Miocene	6,900-14,400
47.	Bourg	South Louisiana	1952	1.1	0.2	0.9	31	Miocene	12,580
48.	*Paradis	South Louisiana	1939	1.0	0.14	0.86	9	Miocene	9,600-11,100
49.	Boonsville Bend	North Texas	1950	1.0	0.6	0.4	462	Pennsylvanian	2,900- 5,700
50.	*Alta Loma	Texas Gulf Coast	1940	1.0	0.2	0.8	14	Oligocene	7,000-16,000
51.	Keyes	Oklahoma	1943	1.0	0.09	0.91	169	Pennsylvanian	4,100- 4,800
52.	Greenwood	Kansas-Colorado	1952	1.0	0.24	0.76	250	Pennsylvanian	2,600- 3,400
53.	Camrick	Oklahoma	1954	1.0	0.17	0.83	157	Pennsylvanian-Mississippian	4,600- 7,000
54.	*Red Fish Bay	South Texas	1950	1.0	0.32	0.68	38	Oligocene	7,000- 9,000
55.	*Seeligson	South Texas	1938	1.0	0.46	0.54	57	Oligocene	3,200- 7,700
56.	San Salvador	South Texas	1936	1.0	0.5	0.5	57	Oligocene	6,100-10,350
57.	Emperor	West Texas	1934	1.0	0.12	0.88	107	Devonian-Ordovician	3,000-11,500
	Total			275.65	95.906	179.744	63,948		
		(U. S. fields only)		209.75	93.545	116.205	63,416		
		(Foreign)		65.90	2.361	63.539	532		

Note: Of total U. S. gas reserves (262.6 trillion cubic feet as of January 1, 1960), 44.3% lies in major fields. Of total U. S. gas production (170.8 trillion cubic feet), 54.8% has come from major fields.

*These are fields with large associated oil production; others are essentially "pure" gas fields. †Raw gas, incl. CO_2.

1958. For 1959 the addition was 21 trillion, and in 1960 it plunged to 14 trillion. The average addition over the past 15 years has been only 16.6 trillion cubic feet.

In View

There are many areas coming over the North American gas horizon. Perhaps the most promising huge gas reserve of the near future lies in northeastern British Columbia. Although present reserve estimates appear rather low here, recent new discoveries point up this far-western Canadian province as a lively contender to some day top Hugoton.

The thick and widespread Wilcox and Frio rocks along the Gulf Coast of Texas, from the Sabine River to the Rio Grande, already prolific gas producers, will be adding important gas reserves in an ever-growing number. California's Sacramento Valley, although only one field has made the big time yet, will certainly be added to the list in coming years. Wyoming's Green River basin still remains as one of the most noteworthy regions in gasdom. More major fields will hit the list here very soon. There are several that didn't quite make the 100-billion-or-more list this time. Two Mid-Continent basins, Anadarko and Arkoma, are candidates for major gas reservoirs of the near future.

Areas that are still over the horizon, but are expected to reach the point are Texas' Delaware basin, Arizona's Black Mesa, the deeper horizons of the Appalachian geosyncline, and Alaska.

The tables that follow, then, provide a good picture of the habitat of natural gas today. As events unfold, the picture will change, but the frame will ever be . . . geologic environment.

What the tabulations are—and are not

In these two tabulations, the habitat of natural gas today is laid bare. The tables were prepared by Journal editors as a guide to presently known occurrences of gas in quantity. And "guide" they must be . . . these are not precise engineering estimates, but appraisals based on field performance, age, and size. The figures on these pages, for the United States, represent approximately one-half the total domestic reserve.

The other half lies in younger, smaller fields not yet eligible for these tables, and in solution in our great oil fields.

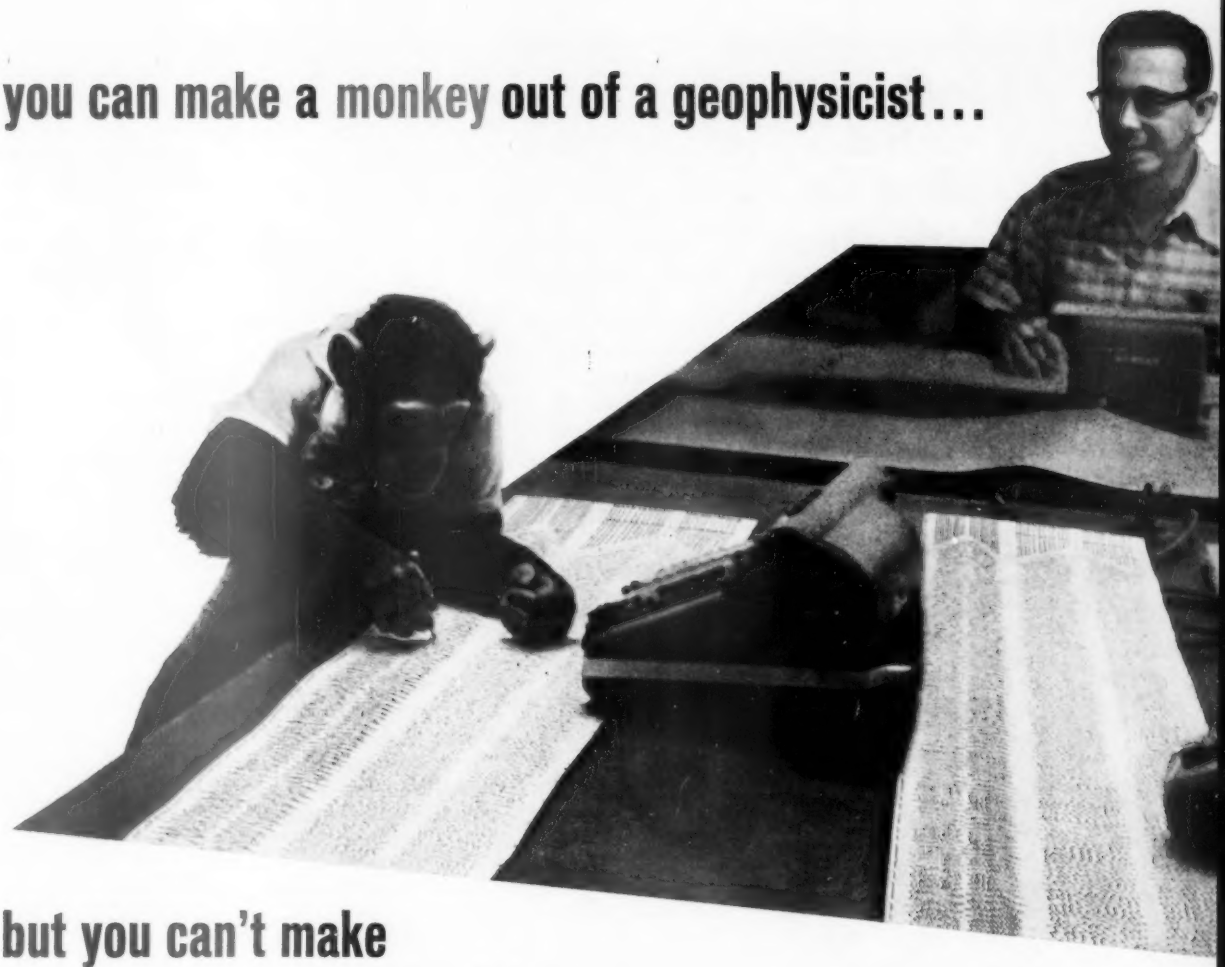
Principal Gas Fields of North America by Basin Habitat

Note: Eligibility for this list requires a cumulative production of at least 100 billion cubic feet of of gas as of January 1, 1960; fields with associated oil reserves must show a cumulative gas production in M.c.f. six times greater than cumulative oil in barrels.

Geologic province, state, and field—	Year discovered	In billions of cubic feet—Original reserve	Cumulative prod. 1-1-60	Est. remaining reserve	Productive gas wells 1-1-60	Producing formation—Age	Avg. depth (ft.)
Green River Basin, Wyoming:							
Baxter Basin (all fields)	1938	185.0	169.7	15.3	105	Jurassic-Cretaceous	1,800- 4,000
Williston Basin, Montana:							
Cedar Creek	1912	214.8	135.7	79.1	232	Cretaceous	600- 1,400
Bowdoin	1913	210.0	100.6	109.4	365	Cretaceous	670
Sweetgrass Arch, Montana:							
Cut Bank	1931	145.0	104.5	40.5	223	Cretaceous	2,600- 3,000
Anadarko Basin, Texas:							
Hansford	1953	508.0	118.6	389.4	201	Pennsylvanian	5,300- 7,300
Permian Basin, Texas:							
Keystone	1935	179.0	112.0	67.0	72	Permian, Devonian, Silurian, Ordovician	2,950- 9,875
Permian Basin, New Mexico:							
Blinebry	1945	770.0	142.0	628.0	148	Permian	5,600
Tubb	1946	194.0	100.0	94.0	147	Permian	6,100
Sabine Uplift, North Louisiana:							
Hico-Knowles	1951	894.0	268.5	625.5	40	Jurassic	8,300
Cotton Valley	1923	874.0	617.0	257.0	49	Cretaceous-Jurassic	2,500- 8,500
Lisbon	1936	810.0	484.6	325.4	47	Cretaceous	4,900
Ruston	1943	797.0	271.1	525.9	39	Cretaceous	5,200
Richland	1926	539.0	456.6	82.4	3	Cretaceous	2,400
Ada	1944	500.0	162.6	337.4	60	Cretaceous-Jurassic	4,400- 9,900
Haynesville, East	1945	360.0	107.9	252.1	15	Jurassic	9,740
Sibley	1936	358.0	172.0	186.0	56	Cretaceous	5,500
Spider	1944	333.0	106.7	226.3	17	Cretaceous	4,900
Athens	1941	332.0	126.4	205.6	49	Cretaceous-Jurassic	5,200- 8,200
Bear Creek	1937	331.0	152.7	178.3	36	Cretaceous	6,600- 7,700
Lucky	1943	312.0	106.1	205.9	25	Cretaceous	6,800
Sugar Creek	1930	228.0	136.6	91.4	20	Cretaceous	4,300
Elm Grove	1916	223.0	195.9	27.1	6	Cretaceous	5,200- 5,900
Lake Bistineau	1916	140.0	130.6	9.4	13	Cretaceous	2,500

Geologic province, state, and field—	Year discovered	In billions of cubic feet— Original reserve	Cumulative prod. 1-1-60	Est. remaining reserve	Productive gas wells 1-1-60	Producing formation— Age	Avg. depth (ft.)
Sabine Uplift, East Texas:							
Willow Springs	1938	942.0	395.8	546.2	118	Cretaceous	6,600- 7,600
Woodlawn	1947	656.0	131.2	524.8	60	Cretaceous	6,300- 6,500
Chapel Hill	1938	575.0	241.6	333.4	23	Cretaceous	5,750- 8,150
Trawick	1949	505.0	113.8	391.2	40	Cretaceous	6,850- 7,500
Whelan	1945	431.0	134.3	296.7	15	Cretaceous	6,775- 7,325
Tyler Basin, East Texas:							
Cayuga	1934	796.0	398.1	397.9	54	Cretaceous	4,200- 7,500
Opelika	1937	716.0	286.5	429.5	47	Cretaceous	7,200- 9,400
Grapeland	1936	381.0	175.7	205.3	11	Cretaceous	5,800- 6,000
Gulf Coast Embayment, Texas:							
McFaddin	1932	939.0	507.4	431.6	78	Miocene-Oligocene	2,200- 6,900
Sheridan	1940	924.0	462.2	461.8	44	Eocene	8,100
Burnell	1944	789.0	295.4	493.6	21	Eocene	6,500- 7,000
Saxet	1923	694.0	569.1	124.9	112	Miocene-Oligocene	1,600- 5,300
McAllen	1938	673.0	370.0	303.0	37	Oligocene	6,000-10,800
North Houston	1938	633.0	265.8	367.2	11	Eocene	6,600- 7,400
Refugio	1928	563.0	436.5	126.5	30	Oligocene	1,950- 6,500
Clear Lake	1938	549.0	230.8	318.2	12	Oligocene	5,500- 5,700
Placedo	1935	539.0	259.3	279.7	70	Oligocene	4,700- 5,300
La Blanca	1937	503.0	221.5	281.5	27	Oligocene	6,650-10,100
South Mayes	1946	499.0	144.2	354.8	16	Oligocene	9,100-11,900
Tom Graham	1938	487.0	204.7	282.3	18	Oligocene	3,500- 5,600
Red Fish Reef	1940	480.0	228.8	251.2	26	Oligocene	7,100- 8,200
Sejita	1939	469.0	187.5	281.5	9	Eocene	5,300- 5,500
La Rosa	1943	456.0	192.6	263.4	12	Oligocene	3,100- 6,100
Bammel	1937	454.0	200.1	253.9	29	Eocene	6,200
Dickinson	1934	419.0	209.5	209.5	40	Oligocene	7,400-10,000
Lake Creek	1941	415.0	166.1	248.9	19	Eocene	8,800-11,800
Willow Slough	1937	396.0	174.4	221.6	32	Oligocene	8,000- 8,800
Spanish Camp	1936	376.0	173.1	202.9	37	Oligocene-Eocene	2,900- 7,200
Angleton	1939	373.0	149.3	223.7	19	Oligocene	8,700-10,500
West Beaumont	1936	372.0	171.6	200.4	21	Miocene-Oligocene	2,400- 6,100
Blessing	1940	356.0	150.2	205.8	7	Miocene-Oligocene	8,300
Francitas	1938	325.0	136.6	188.4	8	Oligocene	7,700
Collegeport	1939	320.0	128.0	192.0	56	Miocene	2,000- 5,600
Needville	1941	266.0	106.2	159.8	14	Miocene-Oligocene	3,950- 6,500
Seabreeze	1935	217.0	104.5	112.5	4	Oligocene	8,500- 9,600
Moore's Orchard	1926	183.0	120.3	62.7	16	Miocene-Oligocene	1,200- 8,100
Pledger	1925	160.0	123.4	36.6	33	Oligocene	6,750
Gulf Coast Embayment, South Louisiana:							
Lake Arthur	1937	759.0	416.8	342.2	52	Miocene	9,950-15,250
Pecan Lake, South	1951	690.0	157.6	532.4	27	Miocene	8,500-13,000
Lirette	1937	640.0	351.6	288.4	25	Miocene	8,400-10,500
Shuteston	1943	626.0	250.6	375.4	36	Miocene	9,500-10,900
Houma	1945	624.0	218.1	405.9	24	Miocene	10,300-11,800
Ville Platte	1937	623.0	342.3	280.7	44	Eocene	8,900-10,200
Tigre Lagoon	1947	530.0	159.1	370.9	20	Miocene	10,600-12,000
Gibson	1937	508.0	223.7	284.3	28	Miocene	8,600-10,300
Lake Sand	1949	475.0	135.6	339.4	15	Miocene	10,000-11,600
Mud Lake, East	1947	470.0	141.2	328.8	16	Miocene	9,400-11,300
Tepetate, North	1938	465.0	244.6	220.4	35	Miocene	7,700- 9,000
Hollywood	1953	414.0	125.1	288.9	17	Miocene	12,200-14,400
Lake Long	1937	392.0	215.5	176.5	16	Miocene	9,300-11,300
Turtle Bayou	1949	386.0	108.8	277.2	14	Miocene	11,250-12,000
Pecan Lake	1944	350.0	131.1	218.9	15	Miocene	8,200-11,750
Chalkley	1938	300.0	126.2	173.8	17	Miocene-Oligocene	7,100-11,800
Elton, North	1939	293.0	117.2	175.8	30	Miocene	6,000- 8,700
Valentine	1936	281.0	161.3	119.7	23	Miocene	3,800-11,800
Bayou Mallet	1936	252.0	115.8	136.2	42	Miocene	4,500- 9,200
Lakeside	1941	127.0	109.5	17.5	6	Miocene	10,000
Mississippi Salt Basin, Mississippi:							
Pistol Ridge	1951	730.0	166.8	563.2	141	Eocene-Cretaceous	4,500-11,500
Maxie	1952	633.0	126.5	506.5	66	Eocene-Cretaceous	4,400- 8,200
Jackson	1930	117.5	117.5	Depleted	0	Cretaceous	2,400
Sacramento Valley, California:							
McDonald Island	1936	152.0	151.4	0.6	1	Eocene	5,220
San Joaquin Valley, California:							
Paloma	1934	510.0	318.6	191.4	4	Pliocene	4,200- 5,500
Trico	1934	211.0	131.8	79.2	47	Pleistocene-Pliocene	2,500- 3,200
Western Canada, Alberta:							
Viking-Kinsella	1914	368.0	332.0	36.0	114	Cretaceous-Devonian	2,100- 2,500
Jumping Pound	1944	331.0	141.9	189.1	11	Mississippian	9,700
Mexico, Tamaulipas:							
Reynosa	1948	563.0	225.2	337.8	74	Oligocene	4,600
Mexico, Tabasco:							
Jose Colomo	1951	500.0	150.0	350.0	36	Miocene	5,200
Total North America		41,588.3	18,757.9	22,830.4	4,190		
Total foreign		1,762.0	849.1	912.9	235		
Total United States		39,826.3	17,908.8	21,917.5	3,955		

you can make a monkey out of a geophysicist...



but you can't make a geophysicist out of a monkey!

It doesn't take a monkey to tell you that you get only what you pay for — in the geophysics field as in others.

One of our camp followers, Fidel by name, puts on a pretty good act among the record sections, slide rules, and delicate electronic equipment and looks sort of professional behind a desk.

Fidel might be taught to perform some fundamental chores with only an occasional banana break, but if any oilfields were discovered through his antics, they would be strictly accidental — and you can't afford to gamble on accidents.

The moral is this: Leave your geophysics to the proved professionals.

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ROGERS' CREWS GO EVERYWHERE

HERE ARE 28 DEEP WILCOX FIELDS along a 200-mile trend stretching from the Rio Grande to Houston; each one produces from below 8,500 ft., and nearly all have found within the past 5 years. Fig. 1.

Gas in the Wilcox lies deep

and it's a bonanza for South Texas

ABOUT 5 YEARS AGO, South Texas had reached some kind of plateau in exploration. Development drilling of old fields was about finished, routine discoveries continued to be made, but there was little to stimulate the imagination or to fire enthusiasm. Nothing new had come along in years, and wildcatters were having a siesta.

Then, suddenly, two massive plays broke over the entire region and jolted it into a new era . . . the deep Edwards Trend and the deep Wilcox Trend. Neither was really new, but like many another big campaign, it took a prolific discovery to remind the industry that it was sitting on top of a second crop of plums. For the Edwards, it was Fashing . . . for the Wilcox, Lopeno.

The history of the Edwards is reviewed elsewhere in this issue (see page 136). The Wilcox has become so widespread that to document it completely is beyond the scope of these pages. The regional perspective, however, is revealed by the map above. The field perspective, and the rewards to be claimed from Wilcox pay, are brought out in the case history to follow.

The Wilcox is a tough nut to

crack. It's an unusual formation, difficult to predict, erratic in facies, and a challenge to the rockhound. A typical Wilcox section may be sand of varying porosity and permeability, shot through with thick sections of shale.

Shallow fields in the upper Wilcox were no novelty to South Texas; there was a veritable Wilcox boom in the late 1930's, and yet another in the late 1940's. But geological prejudice dictated "no pay in the deeper Wilcox . . . if the upper beds are dry, so are the lower ones." As a result, few holes went beyond the upper Wilcox section.

But in 1952, a deep hole in old Lopeno gas field should have signaled events to come. Standard Oil Co. of Texas finished its 1 Ramirez in the deep Wilcox after testing five separate gas pays between 7,000 and 10,180 ft. Many observers with vision predicted in 1953 the boom that envelops South Texas today. But in the upper reaches of the coast, a quartet of Wilcox flops raised a danger signal that was to delay the play for at least 2 years. In Fort Bend and Harris counties, two 1954 deep tests failed after bottoming out in Wilcox at depths of 12,500 to 12,800 ft. Then, farther down the coast, in Jackson County, two more duds hit the record books and gave the lower Wilcox a black eye. In 1955, a deep well in Morales field found the section barren at 10,904 ft.; it had not one sand section between 4,700 and 10,900 ft. In West Ranch field, a superdeep test went to 19,056 ft. and drilled no sand below 8,500 ft.

Finally, in 1956, Atlantic Refining Co. and Tidewater Oil Co. hit in the Wilcox at old Normanna field in Bee County. A 53-million-cubic-foot gasser at the 1 Rabe did the trick. Production came from 8,920-68 ft. At about the same time, Magnolia Petroleum Co. (Mobil) hit at its 1 Von Roeder in DeWitt County to the north; its discovery made 141 bbl. a day of Wilcox oil at 9,300 ft.

Geologists took a look. The map starers gaped at the possibility of a Wilcox Trend stretching from the Rio Grande to Houston, and the play was on. Seismic activity in the region soared by 38.6% in 1958. The results shown on the map are only part of the story, for the fields mapped are only the ultradeep ones, where the producing sands lie below 8,500 ft. Many others produce at shallow depths, still in the lower and middle Wilcox sections. Pipelines moved in, and stimulated the play.

And so, South Texas stands today as one of the most active gas theaters in the nation. The trend widens with time, stretching ever coastward and ever deeper. Climax of the search came in early 1961, with the discovery of Hector Vela in eastern Zapata County, when Gulf Oil Corp. finished the 1 Vela as the deepest Wilcox producer yet; the well flowed 12,200 M.c.f. per day (open) from an interval at 13,272-82 ft., after drilling to 14,034 ft.

To understand the true importance of these Wilcox finds, let's take a look at a type field, and probably the biggest one yet uncovered, as Author Wayne Wood of Blanco Oil Co. takes us on a tour of . . .

Northeast Thompsonville . . .

A typical case history of a deep Wilcox field

BY A. WAYNE WOOD
Geologist, Blanco Oil Co.
San Antonio

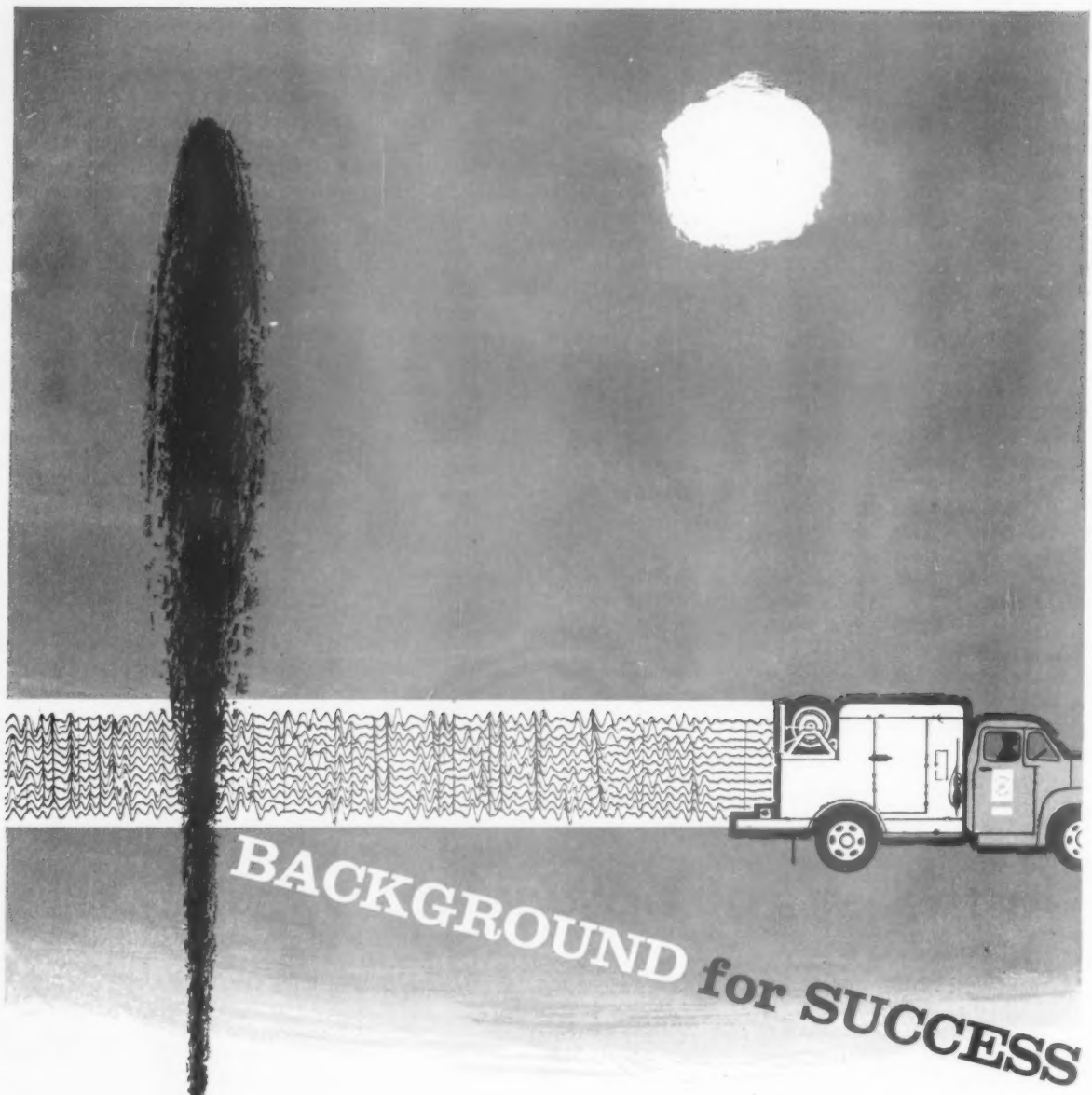
NORTHEAST THOMPSONVILLE field is located principally in the northwest corner of Jim Hogg County, Texas, and the adjacent area to the north in Webb County. When the field is fully developed, it is possible that the productive area will extend into Zapata County to the west and southwest of present production. The productive Wilcox sand is of Eocene age.

The discovery well was the Atlantic Refining Co. and Austral Oil & Gas Co. 2 Marrs McLean, completed June 27, 1959, through perforations at 9,510-63 ft. in the First Hinnant (Wilcox) sand; open-flow potential was 63,000 M.c.f.d. This was the second attempt by these operators to find the field; the first, 1 McLean, was downthrown on the controlling fault at the Hinnant sand; it was plugged at 13,159 ft.

Through February, 1961, 14 gas wells have been completed and there are 8 drilling or projected wells. The rather large area now covered by the field includes several old shallow producing areas which have been deleted from the accompanying map in order to show only those wells which were drilled to the Wilcox formation.

Structure

This field was found as a result of an extensive seismograph survey of the general area. The 1 McLean cut a 635-ft. fault below the First Hinnant sand, so the second well was located far enough to the west to cut the fault above the Hinnant. It cut a 270-ft. fault at −8,080 ft. and established the production. The fault is very low-angle, about 29°. The now-abundant subsurface control reveals the structure as a simple closure on the high side of a north-south trending down-to-the coast fault; the throw varies from 240 ft. in the Atlantic 1 Bruni at the north end of the field to 1,010 ft. in the Atlantic 1-A McLean, a downthrown dry hole in the south end of the field. The throw diminishes going westward or downstructure; the highest cut, Atlantic 1 Holbein at −5,476 ft., cut only 145 ft. The west offset to this well is not faulted, showing the fault to be of no effect through the



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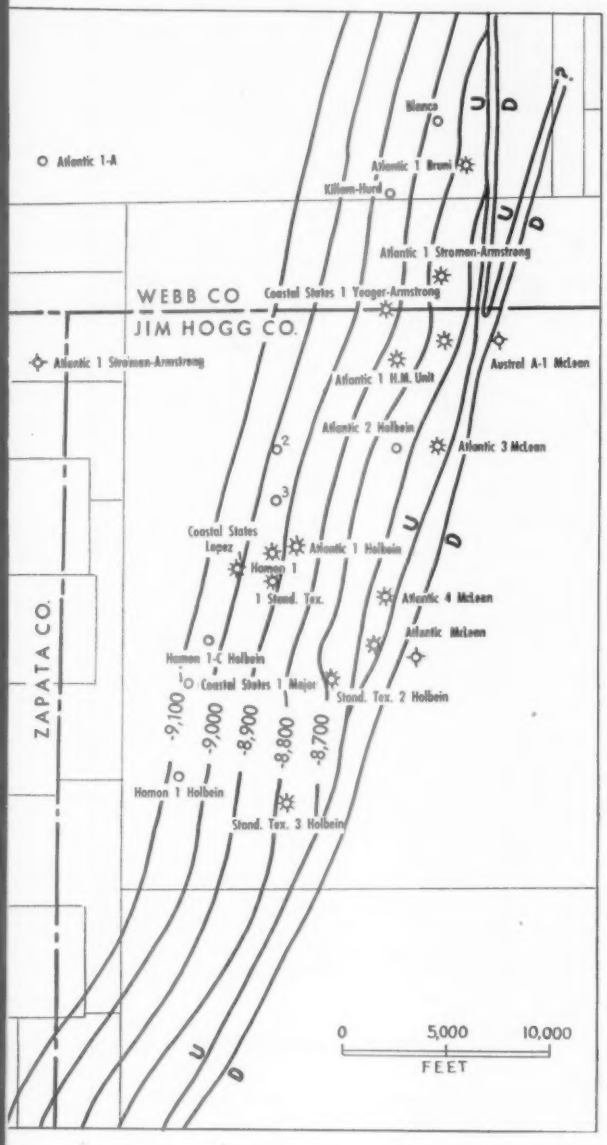


STRUCTURE MAP of Northeast Thompsonville field reveals the anomalous westward dip of the productive Wilcox beds. A down-to-the-coast fault limits production to the east, but the field is undefined on the west, north, and south. Contours are on top of the First Hinnant sand, interval 100 ft. Fig. 2.

Queen City formation. This made the shallow subsurface control useless insofar as this field is concerned. The Atlantic 1 Stroman-Armstrong cut two faults as shown on the map.

Reservoir Factors

This is easily one of the largest gas fields, both areally and from the standpoint of reserves, to be found in South Texas in recent years. As of February 20, the field measured 6½ miles long north and south (strike) with a maximum width of 2 miles. From the top of the sand in the highest well at −8,560 ft. to the base of the sand at −9,054 ft. in the lowest well, the proved gas column is 494 ft. There has been no water level encountered in any of the wells drilled where the Hinnant sand is upthrown on the fault. Open-flow potentials are high, and there is no question as to the ability of the wells to deliver contract quantities on a reserve basis. The one pay sand varies from 74 ft. net near the fault, to 60 ft. on the western extremity of the field, with average thickness being about 65 ft. The physical properties of the reservoir rock are as follows from core data on the Atlantic 3 McLean.

- Average porosity 23.2%.
- Average permeability 154 md.
- Original reservoir pressure 6,855 psia. at −8,700 ft.
- Interstitial water 21.6%.
- Original reservoir temperature 283° F.

Recent authoritative estimates of proved reserves behind the first 12 completed wells give the field approximately 7,000 proved productive acres, with a reserve in excess of 640 billion cubic feet of gas.

The gas is extremely lean in liquids, gas-oil ratio being in the neighborhood of 150,000:1.

With these data the majority of the operators were able to obtain the following field rules:

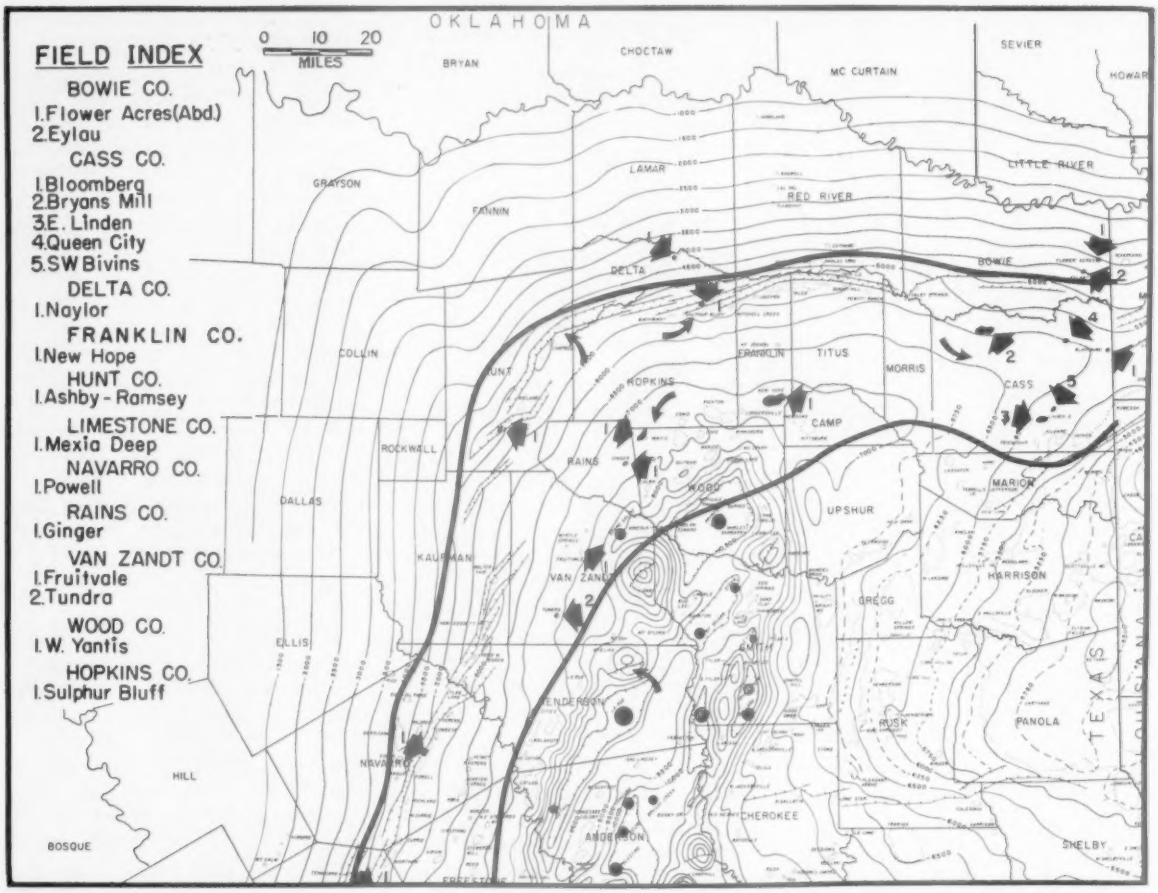
- 660-1,320-ft. spacing.
- 640-acre gas proration units + 10% tolerance with maximum diagonal of 9,000 ft.
- Allocation based on two-third acreage + one-third per well.
- Surface casing set at 1,000 ft. and intermediate string to be no shallower than 7,500 ft. nor deeper than 9,000 ft.

Drilling conditions vary from good to poor, according to the amount of lost circulation encountered while drilling to 7,500 ft. After intermediate string is set, mud weight is brought to above 15 lb. before drilling into the Hinnant sand. The length of time to drill a well through the First Hinnant sand is 35 to 40 days. Outlets for the gas are two: Coastal States Gas Co., and Texas-Illinois Pipe Line Co. which will pay the top price of 18½ cents per M.c.f.

Outlook

This field has been defined only on the east side. It is open on the north and south ends and no water has been found to the west. However, it would seem that either a structural saddle or fault will be found west of the west edge wells to account for the change of dip from west across Northeast Thompsonville to east across Taquachie Creek field to the west. The Gulf Oil Corp. 1 Vela, located in Zapata County 6½ miles south of the most southerly field well found the Hinnant sand downthrown, but well developed. A large fault was reportedly cut below the Hinnant sand and a number of sands showing gas were found on the upthrown side down to total depth of 14,040 ft. The well was recently completed as a gas well through perforation at 13,270-80 ft. No field well has drilled to sufficient depth to test these sands.

When an approximate upthrown restored Hinnant sand datum is applied to the Gulf 1 Vela it becomes apparent that the field could extend much farther southward than present development. To the north end of the field, wells being drilled by Blanco Oil Co. and Killam & Hurd will provide some indication of the northward extent of the field. In the southwest part of the field, the Coastal States 1 Major and the Jake Hamon 1 Holbein will provide valuable data as to the southwesterly and downdip extremities of the field.



THE SMACKOVER POROSITY TREND curves around the western and northern perimeters of the East Texas embayment, and covers about 8,100 sq. miles. The updip limits are formed by the subcrop limits of the Smackover, and the downdip limits are fixed by the observed absence of dolomite. Straight arrows denote producing Smackover fields, curved arrows are drilling wells as of March 15, 1961. Contours on base of Massive anhydrite, interval 500 ft. (Base map courtesy East Texas Photocopy Co., Tyler.) Fig. 1.

East Texans dance the "Jurassic Jump"

. . . as natural gas calls the tune

BY R. W. EATON
Consultant, Tyler, Tex.

THE SUCCESS of Jurassic exploration in Northeast Texas during 1960 gave the first promise of industry-wide profit in 23 years of effort.

Twenty exploratory tests were drilled, and seven resulted in new Jurassic discoveries; five were from the Smackover and two from the Cotton Valley.

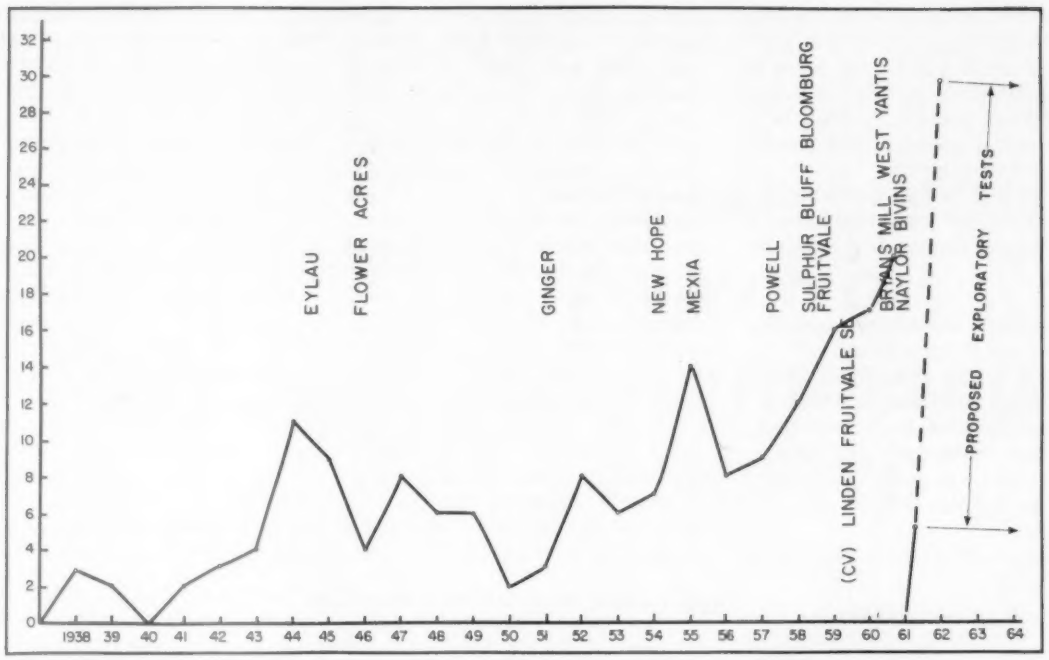
Two of the new fields, Bryans Mill in northwestern Cass County, and West Yantis in northwestern Wood County, are considered to be the most significant Smackover discoveries since New Hope field in 1954.

Bryans Mill was discovered by Shell Oil Co. 1 Alsup, completed on March 8, 1960. From perforations between 10,297 and 10,367 ft., the well flowed 792.2 bbl. of 53.2° condensate through on 18/64-in. tubing choke.

Equally as impressive was Pan American Petroleum Corp. 1 J. B. McKee, discovery well for West Yantis field, completed July 29, 1960. From perforations 12,765-95 ft., the well had a potential of 1,101.1 bbl. of 60.6° condensate on a 20/64-in. tubing choke.

Principally owned by Shell and Cities Service Oil Co., Bryans Mill field now has six completed wells on 320-acre units, with two wells drilling and one location. Averaging 40 to 45 ft. of net pay, individual wells are expected to produce a gross revenue in excess of $10,500,000. Shell recently announced plans for installation of a 30-M.M.c.f.d.-capacity cleaning plant and cycling system for the field to be placed on stream this fall.

Two wells have been completed and a dry hole drilled by Pan Amer-


EYLAU
FLOWER ACRES
GINGER
NEW HOPE
MEXIA
POWELL
SULPHUR BLUFF BLOOMBURG
FRUITVALE
(CV) LINDEN FRUITVALE SE
BRYANS MILL WEST YANTIS
NAYLOR BIVINS
PROPOSED EXPLORATORY TESTS
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32
1938 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64

THE 23-YEAR HISTORY of Smackover exploration in Northeast Texas is one of sporadic interest. The rewards of post-1950 drilling have whetted the appetite of East Texans for this deeply buried objective. Fig. 2.

ican in West Yantis field. In addition, one wildcat is drilling some 3 miles northeast of the discovery and two field locations have been announced. The net productive section here is somewhat thicker than at Bryans Mill. Here, too, the unusually high condensate yield of the gas gives the individual wells an estimated gross value in excess of $6,000,000.

The other new fields in 1960 were Smackover gas discoveries in Delta, Hunt, and Cass counties, and one oil and gas discovery from the Cotton Valley beds, both in Van Zandt County. Thus far in 1961, five exploratory wells have proved dry in Jurassic beds and one important stepout for East Linden Cotton Valley field of Cass County has been completed.

Fig. 1, a structural map of Northeast Texas, shows the location of all Smackover and Cotton Valley production in the area.

As of March 15, 1961, five Smackover wildcats were drilling, one each in Cass, Henderson, and Hunt counties and two in Hopkins County. Old Eylau field of Bowie County has a well drilling. Current field development includes one well drilling and one location in East Linden Cotton Valley field, the confirmation well drilling in newly discovered Queen City field of Cass County, a new location and an announced reentry for New Hope field, Franklin County, the confirmation well running production tests in Ashby Ramsey field of Hunt County, and two wells in Sulfur Bluff, Hopkins County. The locations of these wildcats are shown on Fig. 1. Some of the basic data for all Jurassic fields in the area are shown in Table 1.

Busy year ahead. In preparation for this report, a check of the industry reveals plans for the drilling of 23 exploratory tests during 1961. Of these, 18 are in the final planning stage and 5 are considered doubtful for various reasons. These proposed wells are distributed over the northern tier of counties as follows: Bowie County, two, one questionable; Cass County, six; Camp County, one; Gregg County, one doubtful; Franklin County, one; Hopkins County, three, one doubtful; Hunt County, one; Kaufman County, one; Marion County, one doubtful; Morris County, two; Rains, Rusk and Wood counties, one each; and Titus County, two.

The Background

Interest in the Smackover limestone sequence in Northeast Texas as a source of future petroleum reserves was stimulated as early as 1938 by the well-established production from these beds in South Arkansas.

One of the first exploratory tests specifically projected to these beds was Stanolind Oil & Gas Co. 1 Tennie Norris. Drilled along the Mexia-Powell fault zone in western Limestone County, this well was abandoned as a dry hole in 1938. Since then, there have been 228 Jurassic tests drilled in 28 counties of the area. The shallowest of these was slightly below 6,000 ft., whereas the deepest test, Humble Oil & Refining Co. 1 McWatters, in southwestern Freestone County, was abandoned in lower Smackover at 16,347 ft. Some 44 of these tests penetrated only the Cotton Valley beds, 104 drilled into the Smackover section, and 61 penetrated the Pre-Smackover equivalents. Of the remaining 19 wells, 9 entered piercement salt above Smackover equivalents, and 10 wells located along the outer perimeter of the Smackover subcrop limit entered beds of questionable Jurassic age below the Cretaceous.

Chronological development of Jurassic exploration in Northeast Texas since 1938 is shown graphically in Fig. 2. Small peaks of ac-

tivity are reflected following the first Smackover discovery in the area, Eylau in 1944, and Flower Acres in 1945. The peak in 1947 indicates the postwar interest in these beds was at best sporadic. A peak reflecting somewhat greater interest occured in 1951-1952 following the discovery of gas from Smackover at the one-well Ginger field in Rains County.

New Hope showed the way. Beginning with the condensate-rich gas discovery of New Hope field, Franklin County, by Tidewater Oil Co., the importance of the Jurassic beds, and more particularly the Smackover section, was brought into sharp focus as a future source of major reserves.

During 1955 to 1958 New Hope field development proved a major reserve in excess of 5,000 acres of rich sulfur and condensate-bearing gas. This field currently has 17 producing wells drilled on 320 acre units. Early in the development the operators initiated a plan whereby the field would be unitized for the purpose of recycling the gas for maximum recovery of the fluids in the reservoir. In 1960 the completed plant was put on stream at a rated capacity of 50 M.M.c.f.d. It is generally thought that at this rated capacity the unit should gross some $750,000 per month from sales of condensate, butane, propane, and sulfur. Because the total gas column thickness exceeds 500 ft., it is conservatively estimated that the reserves of this unitized field have a gross value in excess of $300,000,000. From the best information available to the writer, total expenditures are estimated at $5,650,000 for drilling and equipment and $4,500,000 for plant and surface facilities. This represents an estimated 30-to-1 minimum net return on investment. Actual figures may be considerably higher.

Following New Hope, relatively minor gas accumulations were found in the two-well Smackover gas field at Mexia in 1955 and Powell in 1957. In 1958 another rich gas-condensate Smackover field was discovered by Grelling Estate in the area of Sulfur Bluff field. The well was completed March 29, 1958, flowing 374.4 bbl. of 64° condensate per day, through a 12/64-in. choke. The condensate-gas ratio was 13,710 to 1. Due to lack of gas out-

TABLE 1—EAST TEXAS JURASSIC FIELD DATA

Field, County, and Disc. Well—	Date comp.	TD. (ft.)	No. wells at pres. Prod.	Drlg.	D&A	Perf. int. (ft.)	Daily potential	Gravity
Ashby Ramsey, Hunt; Teas 1 Chamblis	8-7-60	9,098	1	1	1	8,975-95	23 M.M.c.f.	
						Smackover	37.24 BC/M.M.c.f.	63.6
Bloomburg, Cass; Humble 1 Walters	8-8-58	11,061	1	0	1	Smackover	38.4 bbl.	46.9
						10,380-90		
Bryans Mill, Cass; Shell 1 Alsup	3-8-60	10,603	6	2	0	Smackover	792.2 bbl.	53.2
						10,297-341		
						10,344-352		
						10,358-367		
East Linden, Cass; Pan American 1 Giraud	6-30-59	12,074	5	1	1	Cotton Valley	205.7 bbl.	51.9
						9,864-74½		45.1
						10,254-83	280.8 bbl.	48.8
						10,620-38		
Eylau, Bowie; Barnsdall 1 Heilbrons	9-20-44	7,716	1	1	3	7,705-9		
						Smackover	165 bbl.	41.4
Flower Acres, Bowie; Barnsdall 1 Pickering	8-9-46	7,501	1	0	0	Smackover		
						7,030-88	168 bbl.	71.7
						Open hole		
Fruitvale, Van Zandt; Caraway 1 West	10-14-58	12,754	1	0	0	Cotton Valley		
						12,204-496	16.5 bbl.	65
Ginger, Rains; Caraway 1 Puckett	11-17-54	12,607	1	0	3	Smackover		
						11,958-12,126	203 bbl.	55.8
Mexia, Limestone; Humble 1 Ross	2-12-55	8,614	2	0	1	Smackover		
						8,565-76	121.49 bbl.	50.1
Naylor, Delta; Naylor 2 Young	*10-60	7,100	1	0	2	Smackover		
						6,918-22	est. 4.1 bbl.	est. 63
New Hope, Franklin; Tidewater 1-D Ramey	1-6-54	12,689	17	0	3	Smackover	42.5 M.M.c.f.	
						12,086-12,331	160 bbl./M.M.c.f.	61.5
Powell, Navarro; Texaco 1 Edens	2-2-57	9,244	2	0	1	Smackover		
						8,868-8,900	364.7 bbl.	61.8
						8,730-8,770		
Queen City, Cass; Humble 1 Beavers	(*)	11,612	1	1	0	Smackover	2 M.M.c.f.	
						10,668	5 bbl./M.M.c.f.	?
						10,714		
N. E. Linden, Cass; Sunray 1 Grogan Min.	9-12-60	11,300				Cotton Valley		
						10,327-44	90 bbl.	47
Sulphur Bluff, Hopkins; Grelling 1 Bassham	3-29-58	9,460	1	0	1	Smackover		
						9,324-29	374.4 bbl.	64
W. Yantis, Wood; Pan American 1 McKee	6-29-60	13,614	2	0	1	Smackover		
						12,765-95	1,101:1 bbl.	60.6
Tundra, Van Zandt; Pure 1 Flatt	7-15-60	14,750	1	0	0	Cotton Valley		
						10,676-82	241 bbl.	47.7

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let this well remained shut in until late 1960.

Additional stimulus was reflected with discovery of oil in the Cotton Valley by Pan American at Linden in southern Cass County, and by Reagan Caraway's Cotton Valley gas discovery at Southeast Fruitvale, Van Zandt County, both in 1959.

1960 a peak year—In addition to the previously discussed new fields of Bryans Mill and West Yantis discovered in 1960, Texaco Inc. completed its Cotton Valley oil discovery at Tundra in Van Zandt County and Gibson Drilling Co. et al. completed a Smackover gas discovery in Delta County. Both wells were completed in August 1960. In September Paul Teas completed a Smackover gas well in Ashby Ramsey field of Hunt County, and Sunray Mid-Continent Oil Co. made an oil completion from the Cotton Valley for the discovery well of Northeast Linden field in Cass County. In November, Humble completed its 1 Beavers as the discovery well for Queen City Smackover gas field in Cass County.

Perspective

Information assembled from the Smackover wells drilled in the Northeast Texas area has enabled us to solve the major problems of correlation involving these beds. More particularly, the compiling of detailed data from sample analysis has permitted the blocking out of a rough area covering 8,100 sq. miles within which one can expect to find favorable porosity development in the Smackover section. Within this broad area, as shown in Fig. 1, the effective porosities found are the result of a leaching of the oolitic limestone section and associated dolomite replacement. Unlike the oolitic porosities in South Arkansas, the Smackover section of Northeast Texas rarely exhibits effective permeability unless extensive dolomitization is present. The area outlined above is believed to contain a regional facies change in which widespread dolomitization of the Smackover has occurred. Within this broad area, it is anticipated that local structural conditions will contribute to this process to such an extent that the effective porosities will be considerably thicker on structure than over the area as a whole.

The updip limits of this prospective area, as outlined on Fig. 1, are formed by the subcrop limits of the Smackover, whereas the downdip limits are fixed by the observed absence of dolomite in the section. The reasons for the occurrence of widespread dolomites in this restricted area are not clear at this time. The most plausible explanation for this phenomenon lies within the confines of the hypothesis recently proposed by John Emery Adams in his "Dolomitization by Seepage Refluxion," AAPG Bulletin No. 12, Vol. 44, p. 1912, Dec., 1960.

Further details concerning the over-all stratigraphy of the Jurassic, as well as the zoning of the Smackover section, are contained in a publication of the East Texas Geological Society, "Development and Future Possibilities of the Jurassic," available from the Secretary, 903 Bryant Petroleum Building, Tyler, Tex.

Drilling costs vary. Within the broad belt containing dolomitized facies, porosity thicknesses in the outer or updip areas are rarely less than 25 ft. and rarely more than 75 ft. The downdip sections of this dolomite facies commonly involve from 100 to 500 ft. of the Smackover, giving rise to porosity thicknesses from 75 to 150 ft. Drilling costs in this first porosity belt are $75,000 to $100,000 and range sharply upward in the central and downdip areas from $100,000 to $275,000. The principal cost factor in drilling Smackover wells is the slow rate of penetration and abnormal drilling—bit replacement occasioned while penetrating the hard sands of the Travis Peak and Cotton Valley. Completion costs increase normally in the downdip sections where the average depth is below 12,000 ft.

Sulfur and inert gas are problems. Gas production established within this broad belt has varied considerably in sulfur content. In the outer areas sulfides have ranged from a trace to as much as 6%, whereas in the downdip areas the range is much higher, with a maximum of 42.2% at Ginger and 13.7% at New Hope and 7.4% at West Yantis.

It is observed that in the updip area there appears to be a disconcertingly high incidence of inert material in the gas, principally nitrogen and carbon dioxide. Naylor field in Delta County has an inert content above 61%. Other examples are Ashby Ramsey, 50%; Sulfur Bluff, 25%; Powell, 32%; Mexia, over 60%. This high per cent of inert components results in reducing the B.t.u. ratings of the gas. In the downdip areas the inert contents appear reduced as the sulfides increase. This is no immediate economic problem, however, as it would appear the fields discovered to date will all be subject to a unitized gas recycling-type operation similar to that being utilized at New Hope.

Exploration efforts leading to these recent discoveries have made extensive use of seismic investigation in projecting Cretaceous subsurface anomalies to Smackover depth. We are informed recent improvements in seismic techniques have greatly enhanced the use of this tool in exploring one of our few remaining major frontiers. We are confident the Smackover beds will contribute several additional major fields to the area as a result of the present intensified effort.

BOOKS

THE POWER OF BLACK. By M. B. Longman. Published by Rudo S. Globus, Inc., 40 West Fifty-fifth Street, New York 19. 472 pp. $5.95.

A work of fiction, this novel is hung on the bones of oil history.

The book follows the fortunes of the Ashe dynasty, from the time of the Civil War—and the beginning of the oil industry—to the present. Homer Ashe is the first, and his life is inextricably tied up with oil and the conditions of the day. With his sons, R. E. and Jonah, the scene shifts to Pennsylvania during its heyday. With the next generation the action is Texas and Oklahoma, as the center of the oil industry swings west.

This book spans a century, converting oil history into human history.

A SURVEY OF SECONDARY-RECOVERY AND PRESSURE-MAINTENANCE OPERATIONS IN TEXAS TO 1958. Published by Interstate Oil Compact Commission, P. O. Box 3127, Oklahoma City 5. 106 pp. $2.

This report contains summary data for 258 injection projects initiated since the last report and supplemental data on 632 projects reported in the 1956 report. In addition, brief reports on the progress of the field operations using miscible-phase displacement in four projects are given. Production data are presented graphically for 25 projects.

A bibliography on secondary recovery is also included.

Note: The Oil and Gas Journal maintains a book department. Write to the READER SERVICE DEPARTMENT, P. O. Box 1260, Tulsa 1, for copies of the book list. Often books reviewed here may be purchased from this source.

Gas prospects underlie the revival of Pennsylvania

. . . as success ratio hits 73%

THESE NEW DEEP GAS POOLS were all discovered during the 1960 campaign in Pennsylvania. The trend to deeper drilling continues over the western half of the state, the chief objective being natural gas.

THE GREAT market demand for natural gas has stepped up exploration in the deeper horizons of Pennsylvania and has also increased the development of natural-gas storage pools. Pennsylvania now has the largest storage capacity of any state. Several additional projects are being developed, but more are needed.

More than 90% of the gas used in Pennsylvania is produced in the western part of the United States and is transported to the state by the following corporations: Tennessee Gas Transmission, Texas Eastern Transmission, and Transcontinental Pipeline. The major purchasers of natural gas in Pennsylvania are the companies of the Columbia, Consolidated, and National Fuel systems; and Equitable Gas, North Penn Gas, and T. W. Phillips Gas & Oil companies. These utilities buy all the gas produced in the state at about 27 cents per M.c.f. for the deep gas and 22 to 25 cents per M.c.f. for the shallow gas.

The major market for this gas is residential consumption which accounted for about 55% of the gas. Of the remainder, 25% is consumed by industry and 20% through commercial users. Glass, steel, and brick companies are major industrial consumers.

The major network of gas-transmission lines is in western Pennsylvania in the Pittsburgh area. Ready markets can be found in the Philadelphia area and in smaller metropolitan areas.

Exploration up. Interest in exploring the Keystone State is mounting. In 1960, operators kept two seismic crews busy. More geological field parties were active than in previous years.

Of the 372 wells drilled (excluding underground gas-storage projects and secondary-recovery operations), 24 were oil wells, 249 were gas wells and 99 were dry holes—a success ratio of 73%.

Proved oil reserves in Pennsylvania were estimated at 108,028,000 bbl. on January 1, 1961, while gas reserves were estimated at 1,192,132,000 M.c.f.; production in 1960 totaled 119.7 billion cubic feet of gas, and 67,000 bbl. of condensate. The cumulative production on January 1 was 1,230,392,000 bbl. of oil and 7,410,420,000 M.c.f. of gas for the entire state.

By the end of 1960, a total of 2,115 deep wells had been drilled, of which 1,208 were gas wells, 2 were oil and gas wells, 835 were dry holes, 69 were drilled for gas storage, and 1 is to be used as a disposal well for waste pickle liquor.

Two phases of exploration. Drilling for oil and gas in Pennsylvania falls into two classifications:

- Shallow drilling, completing in formations of Upper Devonian age or younger, and
- Deep drilling, completing in formations of Middle Devonian age or older.

All of Pennsylvania's 1960 discoveries were the result of deep exploration, which resulted in the discovery of one new gas field, eight new gas pools, and one deeper gas pool. It also extended several gas-producing areas, and established a new producing-depth record. Shallow drilling extended several gas and oil-producing areas and continued the development of secondary-recovery projects.

Deep Gas Exploration

Last year, 126 deep wells were completed; of these, 74 were gas wells and 52 were dry holes. Of the gas wells, 61 were development wells, 1 was a successful new-field wildcat, 8 were successful new-pool wildcats, 1 was a successful deeper pool test, and 3 were successful outposts. The total footage of the deep wells amounted to 851,347 ft.

During 1960, 113 wells were drilled to the Oriskany formation or deeper; 70 were gas wells and 43 were dry holes; 11 were completed in the Onondaga chert, 4 of which produced gas. Two wells were abandoned in the Middle Devonian before reaching the Onondaga. Of the 126 deep wells, 63 were fractured and 57 were completed as gas wells. The total open-flow capacities before fracturing amounted to 122,868 M.c.f. of gas daily, compared with 470,919 M.c.f.d. after fracturing. Seventeen gas wells were not

fractured and their total initial open-flow capacities amounted to 142,744 M.c.f.d. The largest initial open-flow potential was 31,272 M.c.f.d. after fracturing a Clearfield County well, Green Glenn Wt. 3954-12.

New developments. After drilling two wells to the Gatesburg formation (Upper Cambrian) on its two offshore blocks in Lake Erie, New York State Natural Gas Corp. has plugged and abandoned the two wells and surrendered its acreage. There has been no other offshore acreage leased from the Pennsylvania Department of Forests and Waters.

Erie County had 10 completions during the year. The only new field discovered in the state during the year was Burgess, in Erie County, by the D. W. Thompson 1 Vandenberg. After fracturing the Medina (Lower Silurian) section, the well produced 430 M.c.f.d. of gas. One of the new-pool discoveries was Tracy pool in western Erie County by Felmont Oil Corp.; the discovery, Pennsylvania Game Commission Tract 101-A No. 1, found gas in the Medina. After fracturing, it produced 600 M.c.f.d. The Russell McConnell 1 Borst was the first well in Pennsylvania to find gas in the Gatesburg sandstone. After working with it for a considerable length of time, the operator was unable to make it a commercial well.

The largest Medina gas producer to date in Pennsylvania was drilled by G. Hall on the J. Lehman farm in Crawford County. This Indian Spring pool well had a natural initial open flow of 6,200 M.c.f.d. of gas.

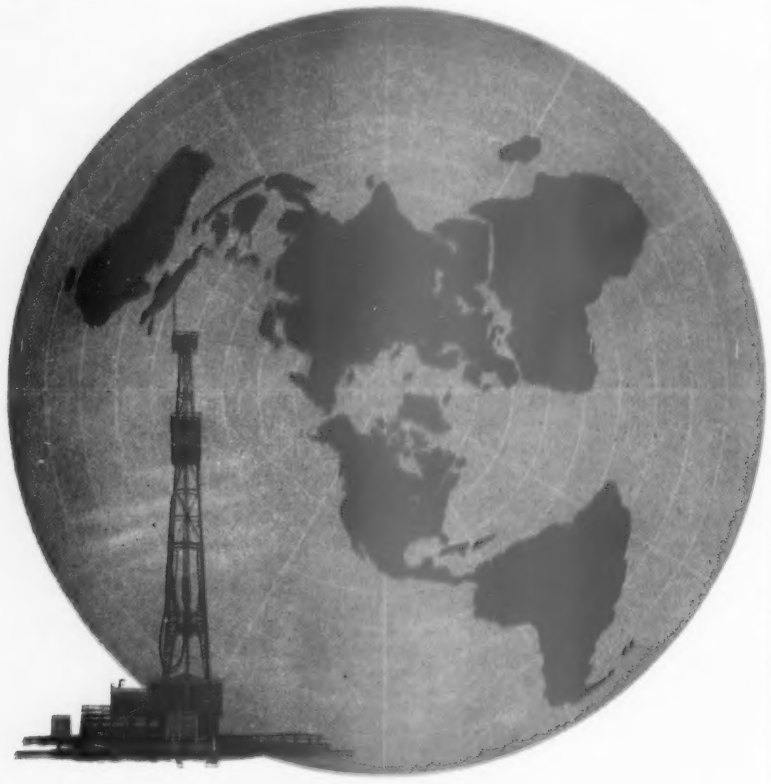
The Biery & Johnson 1 Frank Kapp, a new-field wildcat in Warren County, was abandoned in the Queenston (Upper Ordovician) at a total depth of 5,850 ft. after finding some gas in the Red Medina. Considerable time was spent trying to complete this well as a commercial producer, but due to downhole trouble, it was finally abandoned.

The first deep well in Greene County was finally plugged and abandoned after producing a small amount of gas for a few months. This wildcat, the John T. Galey 1 Herrington, was drilled on the Waynesburg dome-Bellevernon anticline, finding gas in the Oriskany sandstone at 7,953 ft.

A successful deeper-pool test was drilled in Bradford field on the Mallory et al. property by Thunder Rock Producers, finding 500 M.c.f.d. of gas. The well also had a show of condensate.

In Ole Bull pool in Leidy field, Potter County, the Phillips Petroleum Co. 6 Pa. Tract 81 was completed as the largest producer in the pool, with an open flow of 7,770 M.c.f.d. Most of Leidy field has been converted to gas storage. The total cumulative production of this field by the end of 1960 was 155,140,000 M.c.f.

The greatest activity during the year occurred in Punxsutawney-Driftwood field of Cameron, Clearfield, Elk, and Jefferson counties, with 65 development wells drilled. Of these, 47 were development gas wells and 18 were dry holes. Three other wells were successful new-pool wildcats, discovering DuBois, Helvetia, and Sykesville pools. Dubois pool, an extension of the Boone Mountain trend, was discovered by Green Glenn Wt. 3594 No. 1-1 and



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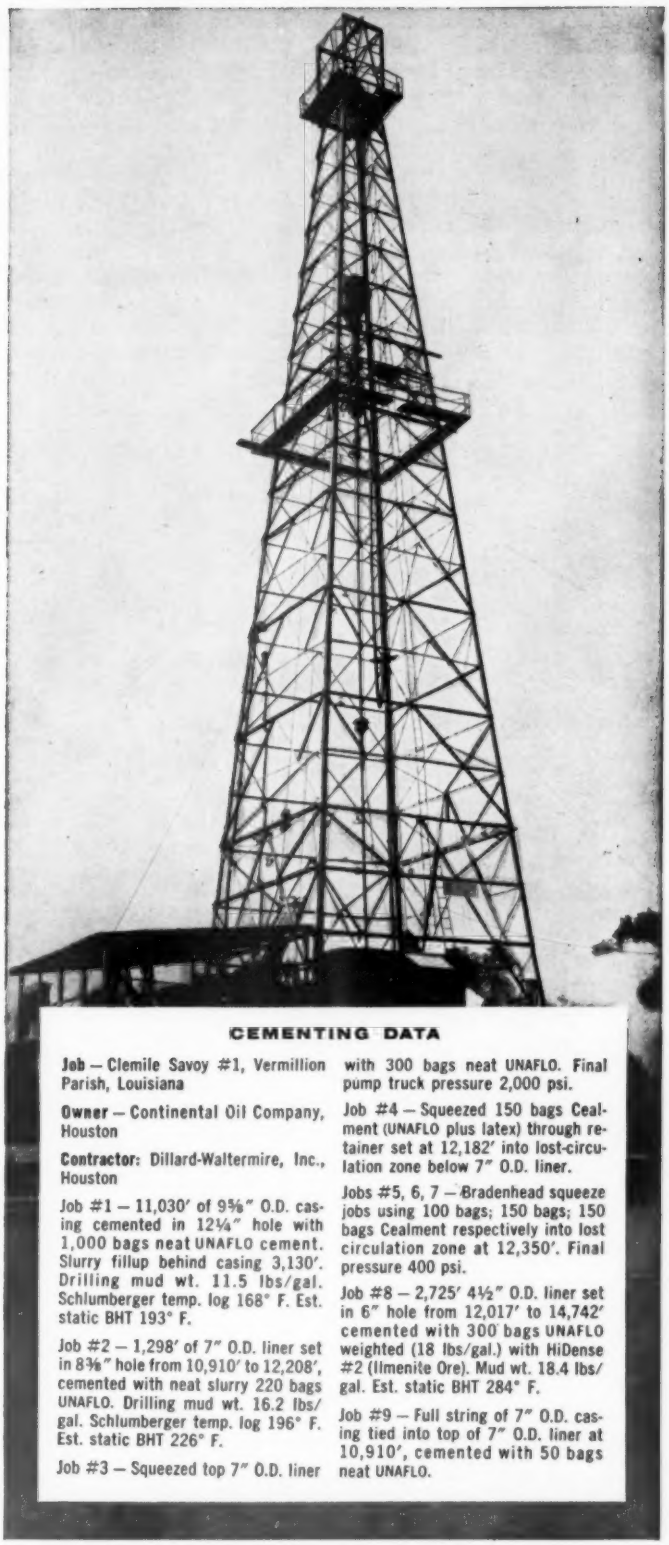

CEMENTING DATA

Job — Clemile Savoy #1, Vermillion Parish, Louisiana

Owner — Continental Oil Company, Houston

Contractor: Dillard-Waltermire, Inc., Houston

Job #1 — 11,030′ of 9⅝″ O.D. casing cemented in 12¼″ hole with 1,000 bags neat UNAFLO cement. Slurry fillup behind casing 3,130′. Drilling mud wt. 11.5 lbs/gal. Schlumberger temp. log 168° F. Est. static BHT 193° F.

Job #2 — 1,298′ of 7″ O.D. liner set in 8⅜″ hole from 10,910′ to 12,208′, cemented with neat slurry 220 bags UNAFLO. Drilling mud wt. 16.2 lbs/gal. Schlumberger temp. log 196° F. Est. static BHT 226° F.

Job #3 — Squeezed top 7″ O.D. liner with 300 bags neat UNAFLO. Final pump truck pressure 2,000 psi.

Job #4 — Squeezed 150 bags Cealment (UNAFLO plus latex) through retainer set at 12,182′ into lost-circulation zone below 7″ O.D. liner.

Jobs #5, 6, 7 — Bradenhead squeeze jobs using 100 bags; 150 bags; 150 bags Cealment respectively into lost circulation zone at 12,350′. Final pressure 400 psi.

Job #8 — 2,725′ 4½″ O.D. liner set in 6″ hole from 12,017′ to 14,742′ cemented with 300 bags UNAFLO weighted (18 lbs/gal.) with HiDense #2 (Ilmenite Ore). Mud wt. 18.4 lbs/gal. Est. static BHT 284° F.

Job #9 — Full string of 7″ O.D. casing tied into top of 7″ O.D. liner at 10,910′, cemented with 50 bags neat UNAFLO.

Universal Atlas Cement Division of United States Steel

produced 30,370 M.c.f.d. from the Onondaga chert-Oriskany sandstone interval, after fracturing. By the end of the year, a total of 29 gas wells and 8 dry holes had been drilled in the pool. Helvetia pool, a separate fault block, was discovered north of Rockton pool on the northwest flank of the Chestnut Ridge anticline. A total of 11 gas wells and 3 dry holes had been completed by the end of the year. Production is from the Onondaga chert-Oriskany sandstone interval. The third pool discovered in the field was the Sykesville; the discovery well was the only one completed in this pool at year's end. The total cumulative production for Punxsutawney-Driftwood field as of January 1, 1961, was 374,500,000 M.c.f. of gas.

An outstanding Westmoreland County discovery was made by Felmont Oil Corp.'s 3 Pa. Game Commission Tract 42, when it found gas in the Onondaga chert-Oriskany sandstone interval, discovering the Baldwin pool. Four gas wells were drilled in this pool during the year, with the largest initial open-flow being 9,115 M.c.f.d. of gas without fracturing.

The 1 Earl Rahl well discovered East Summit pool in Fayette County. Ohiopyle field had two gas producers completed within its limits during the year, one of them discovering Rugg pool. A well in Boswell field of Somerset County discovered Snyder pool.

Shallow Gas Production

The Speechley, Balltown, and Bradford Third sands were again the primary targets for development drilling in the shallow gas fields. The total open-flow capacity of the 175 new gas wells amounted to 100,694 M.c.f.d. The figures used are those obtained after fracturing where that method of well completion was used. From the 143 gas wells fractured, a combined initial open-flow capacity of 97,859 M.c.f.d. of gas was obtained after fracturing, as compared with 4,263 M.c.f.d. before fracturing. There were also 21 gas wells deepened, of which 19 were fractured. Armstrong County, with 54 new shallow-sand gas wells, had the most shallow well completions during the year. Of these, 46 were fractured, raising the combined initial open-flow capacities more than 36 fold.

Outlook

Interest in the development of additional production from the Medina section should continue in Erie and Crawford counties. A show of gas in an Erie County Cambrian test has given operators some hope for commercial gas production from that horizon. With a number of successes in Middle and Lower Devonian rocks along the Laurel Hill and Chestnut Ridge anticlines during the year, this area should continue to be active during 1961. Considerable land has been leased in the central part of the state in the Valley and Ridge province. This area should see a number of wildcats in the next few months. Two wildcats in southeastern Pennsylvania in York County are being watched with interest.

With the Oriskany still being the biggest producer of gas in the state and so very few wells penetrating the section below it, producers are going to continue hunting Oriskany production and put more and more wells down to the Ordovician and Cambrian rocks.

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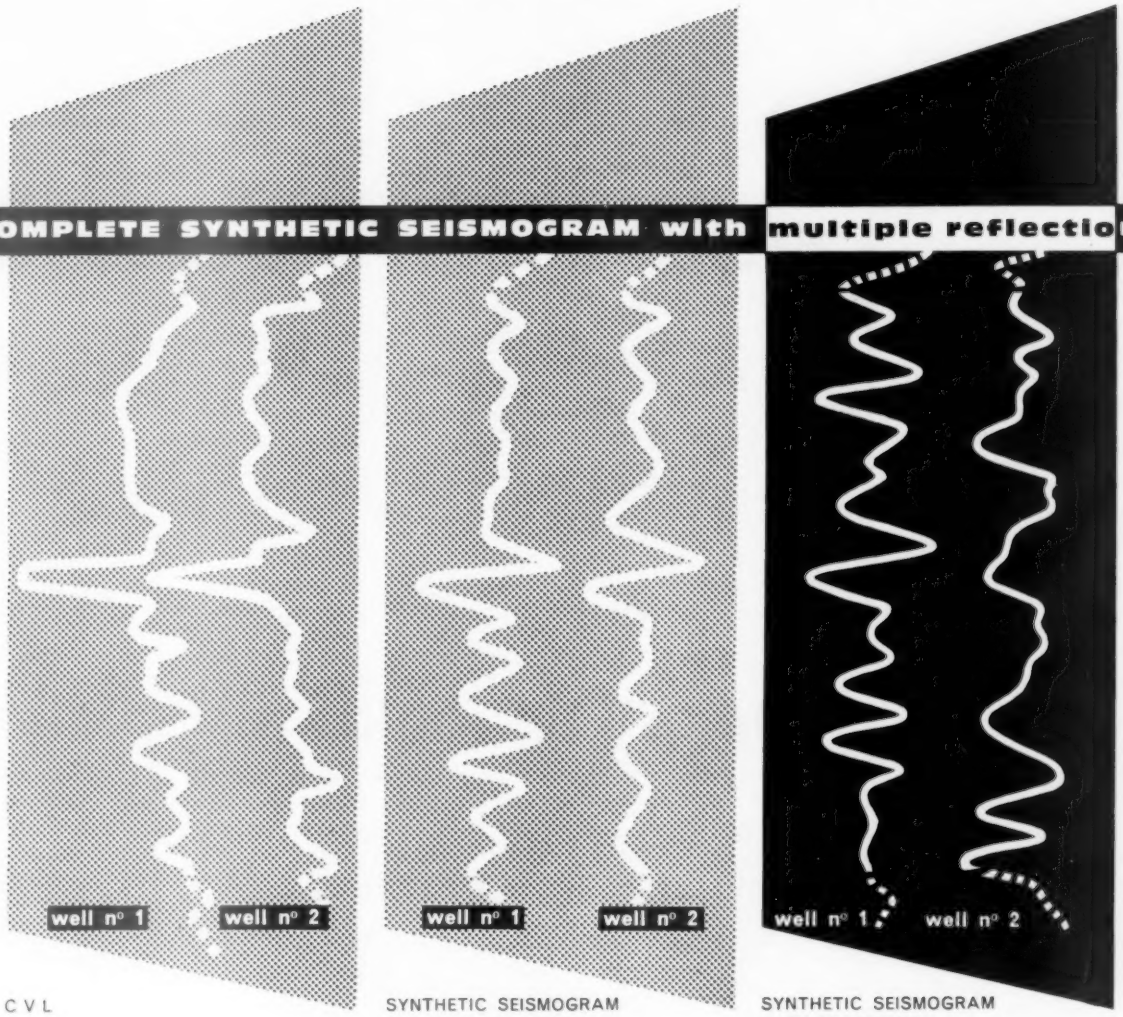

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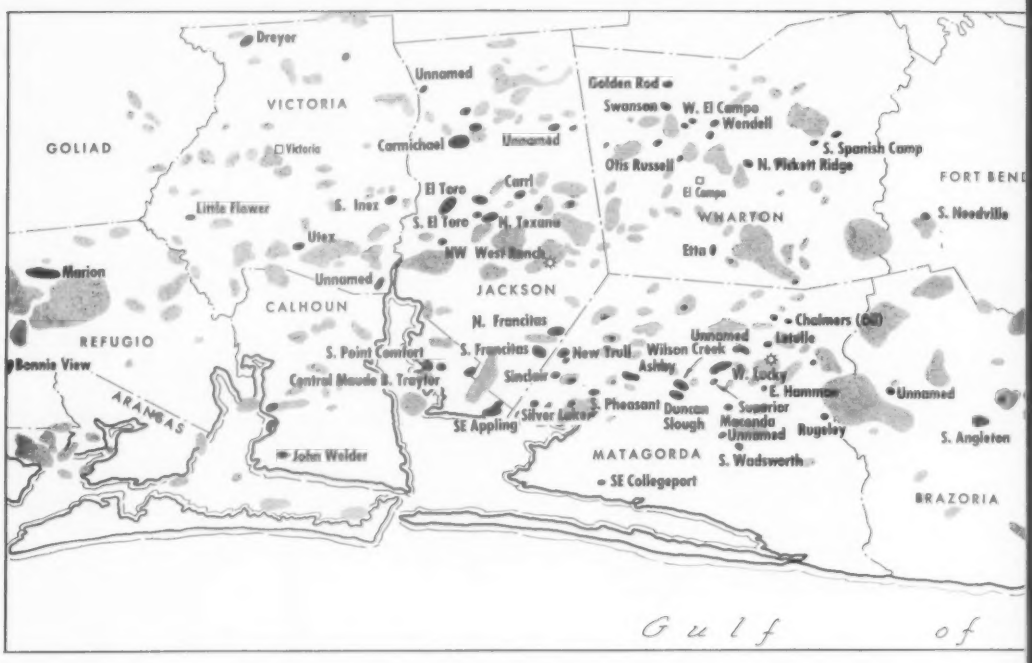


BY
NEIL
WILLIAMS
Associate
Editor

Deep Frio yields a "Golden Gas

THE FRIO TREND, as it stretches into Texas' upper coastal region, appropriately might be called the Golden Gas Lane.

As the backbone of the region's extensive and lucrative oil production, it has also become the source of a buildup of highly prolific and rich gas and condensate reserves.

The trend itself is a 45 to 60-mile-wide band of Frio - Oligocene sand development along the Gulf Coast, reaching in Texas from the Rio Grande in the Starr-Hidalgo county area to the Louisiana line.

Frio sands along the Texas section of the trend already have accounted for many of the country's larger gas fields. Of the 57 fields listed elsewhere in this issue (see page 104) as major gas - producing areas—those with original ultimate recoveries of 1 trillion cubic feet or more—11 are Frio fields on the Texas coast. Twenty more are on the list of 90 other principal gas fields — cumulative production of more than 1 billion cubic feet.

Many more of the Texas coast's Frio fields are potential candidates for places on one or both of these lists. They definitely are indicated to be major gas reserves but because of comparative newness they do not have the productive background to be included.

60 New Fields Found

Among such fields are such notables as the ultrarich Port Acres area, of Jefferson County, and the booming Palacios district, in Matagorda County. Port Acres, discovered and developed within the past 2 years, has been the scene of some of the coast's most prolific wells but has been produced only to a limited extent. Although much older Palacios also has come to the front only within late years with deeper drilling and significant extensions spreading the field over a wide area with multiple oil and gas zones.

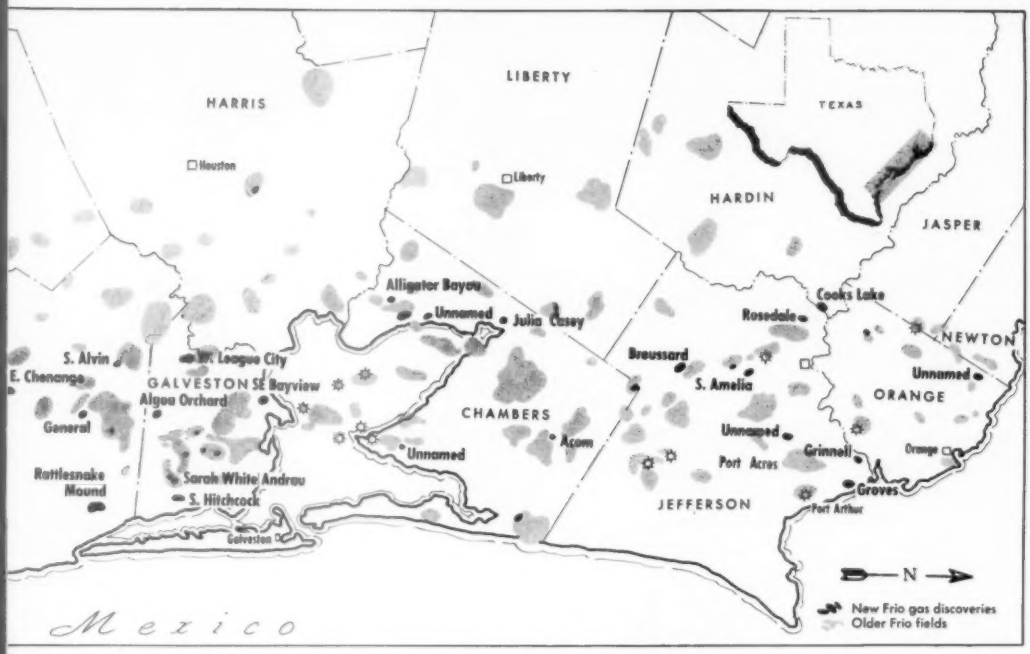
Among those Frio fields ranking among the top gas producers and reserves are such names as Old Ocean, Chocolate Bayou, Alta Loma, Seeligson, Red Fish Bay, Greta - Tom O'Connor, Stratton, Agua Dulce, and La Gloria.

Despite the large number of fields already found in it, the Frio trend remains a prime source for new exploration and finding of additional gas reserves, as well as oil. Not only are additional Frio discoveries being made in rapid succession all along the trend, but changing concepts of structural geology in the downdip reaches of the lower Frio section are opening wider realms of exploration in deeper drilling.

Although exploration and discoveries have continued all along the trend to some extent, principal activity and the more significant and important developments within more recent years have been along the upper coastal portion from Refugio County, northeastward to Louisiana (see map).

Within this portion of the trend alone, more than 60 new Frio gas-productive fields have been discovered since late in 1959. Nearly as many were found during the preceding year. These do not include discoveries of new Frio reservoirs in previously productive fields. Nor do they include some discoveries opening the first Frio production in fields previously productive from other horizons.

Most intensive exploration and development has, and still is, centered in Matagorda County and



NEW DISCOVERIES during past year swell the already long list of rich gas-productive fields along the Frio Trend through Texas' upper coastal counties.

Lane" . . . along the Texas coast

bordering areas of Jackson, Calhoun, Brazoria, and southern Wharton counties. In Matagorda County alone, more than 15 entirely new gas fields have been found within the past year. They add to the dozen or more new fields found the previous year. Frio exploration accounted for eight new fields in Jackson County, eight in southern Wharton, and seven in Calhoun.

Matagorda still is the most active county on the Gulf Coast with nearly 20 wells drilling. Most of them are either out-and-out wildcats or major extensions and exploratory tests around developing fields. With few exceptions all have Frio sands as their objectives. More specifically, these objectives in most instances are in the less-explored lower Frio section. These in most instances call for drilling depths below 10,000 ft.

Although not now as active as Matagorda County and its bordering areas, Galveston, Chambers, and Jefferson counties have been focal points of Frio exploration. All these counties, along with Brazoria County, lie in the heart of the Gulf Coast salt dome basin where the downdip, ultrathick section of the lower Frio offers new challenges to deeper drilling.

Deeper Zones Explored

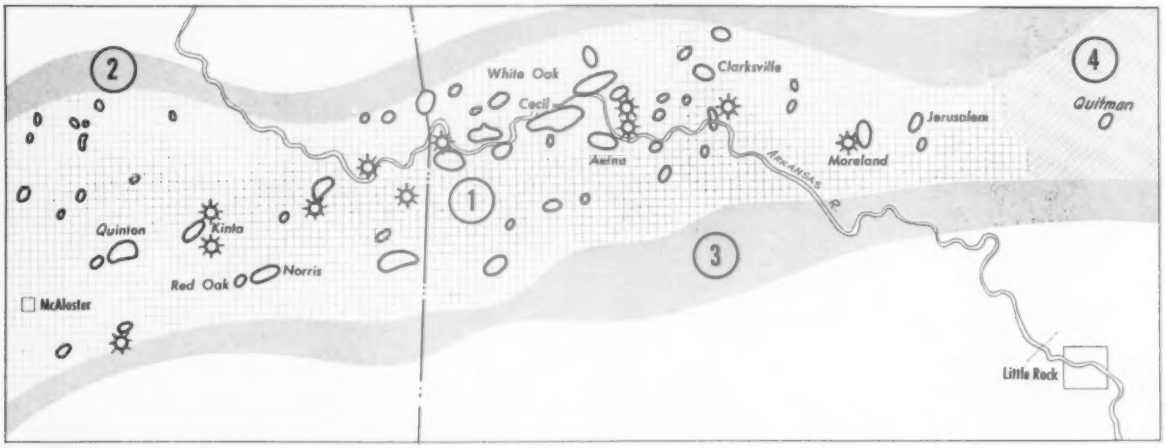
Among the important Frio gas-productive fields, Matagorda County has its expansive, multiple-pay Palacios, Blessing, and Pheasant areas. Brazoria County has its Old Ocean, Chocolate Bayou, Pledger, and South Angleton fields as leading gas reserves. In Galveston County, it has been the deep Frio gas development centered in and around the widespread Alta Loma, Sarah White, and Hitchcock areas. Chambers County is conspicuous for its Willow Slough, South Mayes, Red Fish Reef, Umbrella Point, and North Winnie fields. Jefferson County's new Frio developments are paced by the prolifically rich Port Acres, South China - South Amelia, and West Big Hill areas.

Down the coast in Calhoun County, sizable additional gas reserves have been opened in the recent discoveries of South Point Comfort, Central Maude B. Traylor, and Southeast Appling fields. They augment important new Frio gas production being developed in such slightly older fields as North B. Traylor, Maude B. Traylor, and Appling, and around Seadrift, in the North San Antonio Bay area.

In adjoining Jackson County, the El Toro - South El Toro, South Francitas (which may link with Matagorda County's rich new Trull field just over the county line), North Texana, and Stewart areas figure prominently in new deep Frio gas development.

Exploration to the downdip deeper sand of the lower Frio section has been stimulated in recent years by revelations in deeper drilling of the existence of radically different structural configuration and conditions not evident in the upper horizons. Buried and completely masked by the gently south-dipping upper Frio sediments, these lower Frio structures, north-dipping fault blocks with steep south faces, salt-dome intrusions, and other anomalies have been missed in shallower drilling.

It is significant that most of these previously hidden lower Frio fields at great depth, one below 10,000 ft., have been richly productive of gas and condensate, rather than oil.



THE ARKOMA BASIN, astride the Oklahoma-Arkansas line, consists of four geological areas: numbers in circles indicate (1) the "fairway," scene of most current drilling, (2) the north region, (3) the south region, and (4) the relatively unknown east region. Fig. 1.

Oil finders making long drives on Arkoma basin's "fairway"

Current drilling activity and respectable success ratios point to large reserves of gas

BY ROGER N. PLANALP

. . . geologist with Athletic Mining & Smelting Co. and Leflore County Gas & Electric Co. He is well qualified to evaluate the potentialities of the Arkoma basin, having had considerable experience with the manifold problems involved in drilling and producing Arkoma wells. Planalp has BA and master's degrees from University of Missouri. Prior to going to Fort Smith, Ark., he worked with Gulf Oil Corp. in the Rocky Mountain and Mid-Continent areas.

ARKOMA BASIN drilling activity is showing signs of moving rapidly ahead in the next few years, in spite of tough drilling and completion problems. Several important wildcat wells are now being drilled, and several successful wildcats have been completed in the past few months.

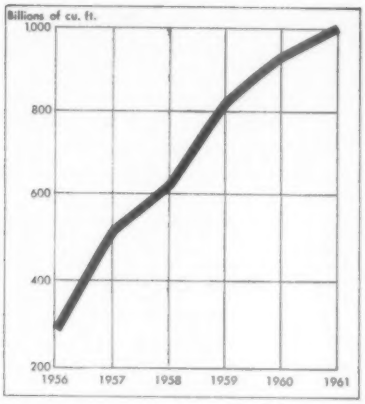
The Arkoma basin can be considered as four separate geological areas as shown in Fig. 1, each with its own geological characteristics and resulting problems; however, there is not a definite line between the areas and in some instances a distinction does not exist, particularly in the Oklahoma portion of the basin.

The "fairway." The majority of drilling has been in a 15 to 20-mile belt extending east-west through the basin. The belt is sometimes referred to as the "fairway" by Fort Smith geologists. The northern edge of the fairway is generally defined by the Mulberry-Linville fault system. The south edge is less clearly defined by the large, highly faulted, steep-dipping structures in the southern portion of the basin and by thrust faults of the Ouachita geological province.

Anticlines in the fairway area are from 10 to 30 miles long and up to 12 miles wide, although in Oklahoma a few are longer. Surface dips are normally under 7°, and the structures are generally symmetrical or only slightly asymmetrical upward to 1,500 ft. Fault angles very between 30° to 60°.

The higher well density in this area has resulted in sufficient subsurface control for most wells to be accurately correlated, especially in the Arkansas portion where deposition of Atoka sediments apparently was more uniform. The Atoka formation ranges from 2,500 to over 9,000 ft. in this area. Surface rocks on the anticlines range from upper Atoka rocks to Savanna sandstones, with the youngest rocks in the area being of Boggy age. These commonly cap the topographically high synclines in the area.

The percentage of sands in the Atoka formation decreases both south and west. The decrease in sand percentage westward is reflected in the relative drilling penetration rates. The 6,000-ft. wells drilled in Pope or Johnson counties, Arkansas, will require between 30 to 150 days (sometimes longer)



THE ARKANSAS Oil and Gas Commission charts the growth of gas reserves in North Arkansas to more than a trillion cubic feet in 1960; most of these lie within the fairway of the basin. Similar figures for Oklahoma are not available. Fig. 2.

to drill with rotary tools. This high figure is due in part to water sands and resulting mud drilling, but without the water problem the well will take a minimum of 30 drilling days and 30 bits. Wells drilled in the Fort Smith area will average 25 drilling days, and 20 bits, under normal conditions.

By comparison farther west in Leflore and Haskell counties, wells will average 20 days, and fewer than 15 bits. LeFlore County Gas & Electric Co. 1 Holt, 33-9n-23e, was drilled to 5,900 ft. in 12 days using six bits. The advantage of faster drilling in the western part of the fairway is obviously offset by the limited number of pay sands, usually 2, as compared with 13 possible pay horizons in Aetna field in Franklin and Logan counties, Arkansas.

The Arkansas Oil and Gas Commission reported discovery wells for 1960 as shown in Table 1.

Area 2 is the region north of the Mulberry and Linville faults. The area is both topographically and structurally higher than the adjacent fairway area. The structures are generally under 10 miles long and 5 miles wide, with surface closure often expressed as several small highs on the anticlinal trends. Dips are generally low except in faulted areas. The Atoka formation is generally less than 2,500-ft. thick in this area.

The high percentage of sand and abundant water zones result in very difficult and slow drilling. Most holes drilled in this area have been dug with cable tools. Current activity in this area includes the development of Rock Creek field by Stephens Production Co. and Arkansas Western Gas Co., and two wells in the Low Gap area currently being drilled by Phillips Petroleum Co. in 10-11n-24w, and 31-11n-23w.

Area 3 is the region south of the fairway and is bordered by the Ouachita geological province to the south. The structures in this part of the basin are very long, ranging up to 75 miles, and 15 miles wide. Overturned beds and steep-dipping flanks are typical, and many of the structures have high-angle reverse faults which help complicate the geology. The Atoka formation is commonly exposed along the axis of the anticlines, with as much as 5,000 ft. of Atoka rocks eroded away on some structures. The Atoka section is 7,500 ft. or more in thickness, and is predominantly shale.

Drilling in this area is normally done with rotary tools using air or gas. The thick shale sections often can be drilled at very high penetration rates. Likewise, when trouble occurs in this area it is generally of a more serious nature than elsewhere in the basin. The steep-dipping shales and fault zones are very susceptible to caving if any water zones are found in drilling, or if mud drilling is used.

The southern part of the Arkoma basin has the most active wildcat drilling today, with the K. & H. 1 U.S.A. in 1-4n-23w drilling in Arkansas. In Oklahoma El Paso Natural Products Co. 1 Webb in 18-5n-23e, and the Ambassador Oil Co. 1 Muncy 19-5n-21e both drilling.

The most active production drilling program has been in the Washburn anticline. Gulf Oil Corp. 1 Duckett in 20-6n-29w, recently reported a natural flow of over 43 M.M.c.f.d. during drilling.

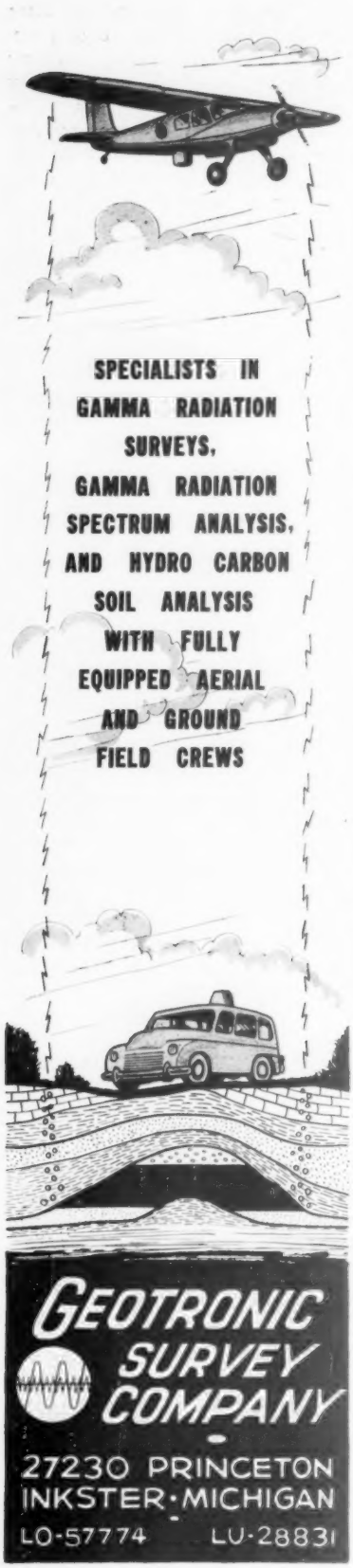
The fourth area is the extension of the other three areas eastward beyond Pope and Conway counties. In this area the surface structures trend to the northeast, and surface closure to the northeast is not present on most anticlines. Subsurface correlations are increasingly difficult eastward, not only for Atoka rocks but also for the Morrow units. The only commercial production in the area is Quitman field, which has one gas well with a calculated open-flow potential of 300 M.c.f.d. Recently Sinclair Oil Co. completed drilling its 1 Carmichael in 11-7n-10w. This hole apparently has been abandoned.

Many geologists feel that the majority of reserves yet to be discovered in the Arkoma basin will be

TABLE 1—NORTH ARKANSAS DISCOVERY WELLS—1960

Field and county—	General location	Operator and well name	Producing formation
New Fields			
Hollis Lake,* Crawford	9- 8n-31w	Parker & Chapman 1 Myers	Atoka
Altus, Franklin	10- 9n-26w	Arkansas Western Gas Co. 1 Weiderkehr	Hale
Ludwig, Johnson	22-10n-23w	Stephens, Inc. 1 T. Landthrip	Atoka
Scottsville, Pope	4- 9n-19w	Murphy Corp. 1 Lee Est.	Hale
New Pools			
Hollis Lake, Crawford	35- 9n-31w	Ambassador Oil Corp. 1 Star Greig	Atoka and Hale
Altus, Franklin	11- 9n-26w	Arkansas Western Gas Co. 1 Timmerman	Atoka
Altus, Franklin	10- 9n-26w	Arkansas Western Gas Co. 1 Weiderkehr	Atoka
Coal Hill, Franklin	3- 9n-25w	Arkansas Western Gas Co. 1 R. Bartlett	Atoka
Ozark, Franklin	28-10n-26w	Mull Drilling Co. 1 Mayner	Atoka
Rock Creek, Franklin	16-11n-26w	Stephens, Inc. 1 U. S. Government	Atoka
Scottsville, Pope	4- 9n-19w	Murphy Corp. 1 S. E. Lee Est.	Atoka

*AOGC Ref. No. 44-60 (previously designated as an extension to the Kibler-Williams field).



found in the fairway, in spite of the higher percentage of drilling already accomplished, and that nearly all surface anticlines have been tested. Fortunately there are many possibilities for subsurface structures yet untested. Atoka thinning northward can shift the anticlinal axis considerably from the surface position. Major unconformities are present in the Atoka formation, particularly near the middle of the section. Faulting can make or break an Arkoma basin project, and several anticlines are cut by subsurface faults which are not recognized on the surface.

The field which is attracting current interest of many operators is the Red Oak gas area where Midwest Oil Corp. and others are drilling deep tests to the Red Oak and Spiro sands. These wells have higher pressures than any previous wells in the Arkoma basin, and have good open-flow potentials, indicating probably high gas reserves for Red Oak.

One of the major wildcat discoveries of 1960 was by Ambassador which found Spiro gas at 8,811 ft. in the 1 Williams unit in 14-5n-18e, Latimer County. This well was completed for 8.3 M.M.c.f.d. and extended production limits of the Spiro sand several miles to the southwest.

Drilling activity is high in the Red Oak, Kinta, and Quinton areas of Oklahoma. In Arkansas the Cecil, Aetna, Rock Creek, Union City, Washburn, and Kibler - Williams areas are under active exploration.

Reserves

Fig. 2 is the Arkansas Oil and Gas Commission chart for total reserves for North Arkansas through 1960. The ultimate reserve estimated through 1960 is approximately 1.15 trillion cubic feet of gas. The Oklahoma reserve figures are not available, however, more than 350 billion cubic feet of gas has been produced, primarily from the Hartshorne sandstone and the basal Atoka-Spiro sand.

North Arkansas gas reserves are primarily in the fairway area. Several of the fields have produced large volumes of gas and pressure-decline curves have been established for reserve estimates. The northern area has few wells, and they are relatively shallow, with comparatively low pressures. To date, the eastern area does not have any gas reserves of significance. The deep wells in Area 3 have encountered high open flows on some wells, while offsets are sometimes dry, or small wells. Until these deep wells are produced the reserves in this area will remain relatively unknown.

Acknowledgment

The data on new pools and fields and Fig. 2 were made available by the Arkansas Oil and Gas Commission, El Dorado.

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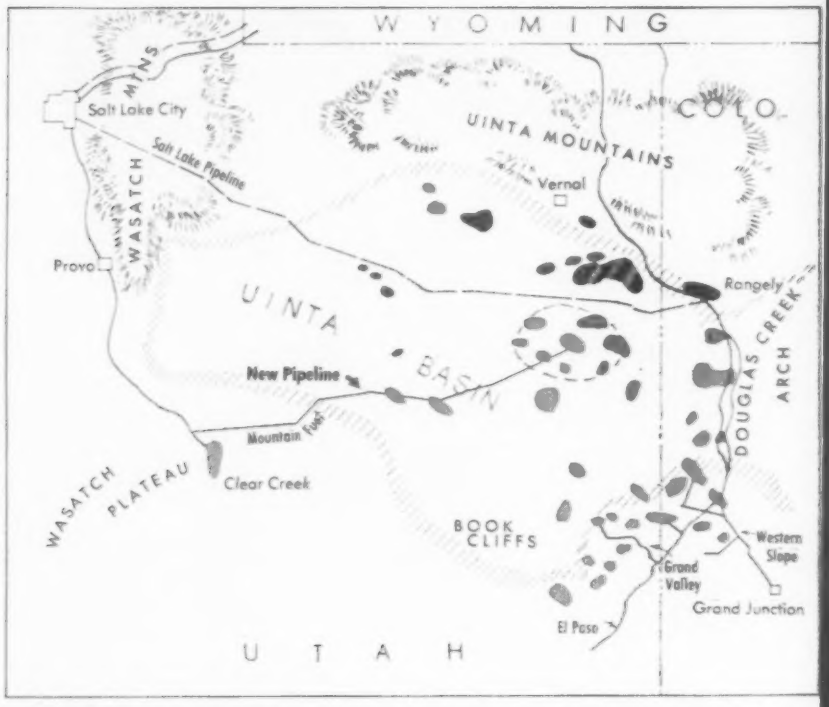
New gas pipeline spurs Uinta basin exploration

The 94-mile line will carry 100 million cubic feet from reserves to Provo-Salt Lake City area

By JOHN C. OSMOND
Consulting Geologist
Salt Lake City



NEW PIPELINE will service the gas fields in the eastern portion of Uinta basin and transport the gas west to commercial and industrial areas. Fig. 1.

BY THE END of 1961, gas will be flowing through a new pipeline across the Uinta basin (Fig. 1). Mountain Fuel Supply Co. is constructing this 94-mile line to carry 100 M.M.c.f.d. of gas from the large proved reserves in the eastern part of the basin. The line will cross the basin and connect with the Utah Natural Gas Co. pipeline near Clear Creek gas field. The gas will be sold in the Provo-Salt Lake City-Ogden area where there is a large demand by smelting and industrial users.

This intrastate gas line will signal the opening of large new areas for gas exploration and provide a much needed outlet for many gas wells which have been completed in the basin in the past 4 years. At present, the only gas sales from the basin are in the eastern and southeastern margins where El Paso Natural Gas Co., Western Slope Gas Co., and Grand Valley pipelines have connections. Additional gas demand may be established when Colorado Interstate Gas Co. and El Paso build the Rock Springs project to deliver gas from this area to California.

Mountain Fuel's action in providing an outlet for the gas reserves will increase wildcat and development drilling to the point where the Uinta basin will take its rightful place among the major producing basins of the Rocky Mountain region. In addition to gas, this drilling activity should find new reserves of oil which could be moved to the four refineries at Salt Lake City. One oil pipeline already crosses the basin, and as Rangely production declines this capacity could logically be made up from the Uinta basin.

Brief History

The first commercial oil in Utah was found at Ashley Valley field on the north rim of Uinta basin in 1948. Production is from Pennsylvanian Weber sandstone (see stratigraphic column). The field is a closed anticline similar to Rangely but much smaller.

Uinta basin has attracted interest since the turn of the century because of the gilsonite and oil-shale occurrences. It has experienced several cycles of exploration activity. The main one, 1948-52, resulted in the discovery of several oil fields in the Tertiary - Green River formation.

The first discoveries were in fractured shales, but later ones have been completed in lenticular sands within the formation. The Tertiary oil has a high wax content and a correspondingly high pour point so that heated surface facilities are necessary. The crude is a good gasoline stock and currently brings $2.50 per barrel at the well.

Red Wash field, with ultimate recovery of over 100,000,000 bbl. is the most important of the Tertiary oil fields and has two rigs drilling in a continuous development program. This field had 152 producing wells at the end of 1960 with a daily production of 11,000 bbl. of oil and 25 M.M.c.f. of gas. The gas is sold to El Paso at 15 cents per M.c.f.

This production is from multiple stratigraphic traps in lenticular sands. Gas is also produced from the Green River formation in one well at Blue Bell and with oil at Roosevelt and Chokecherry in the central part of the basin.

Gas-Producing Areas

Wildcat drilling has thus far outlined two general areas of gas production in the Uinta basin. One of these lies east and south of the central part of the basin and will be called the Uintah gas area.

The other is along the eastern and southeastern margins of the

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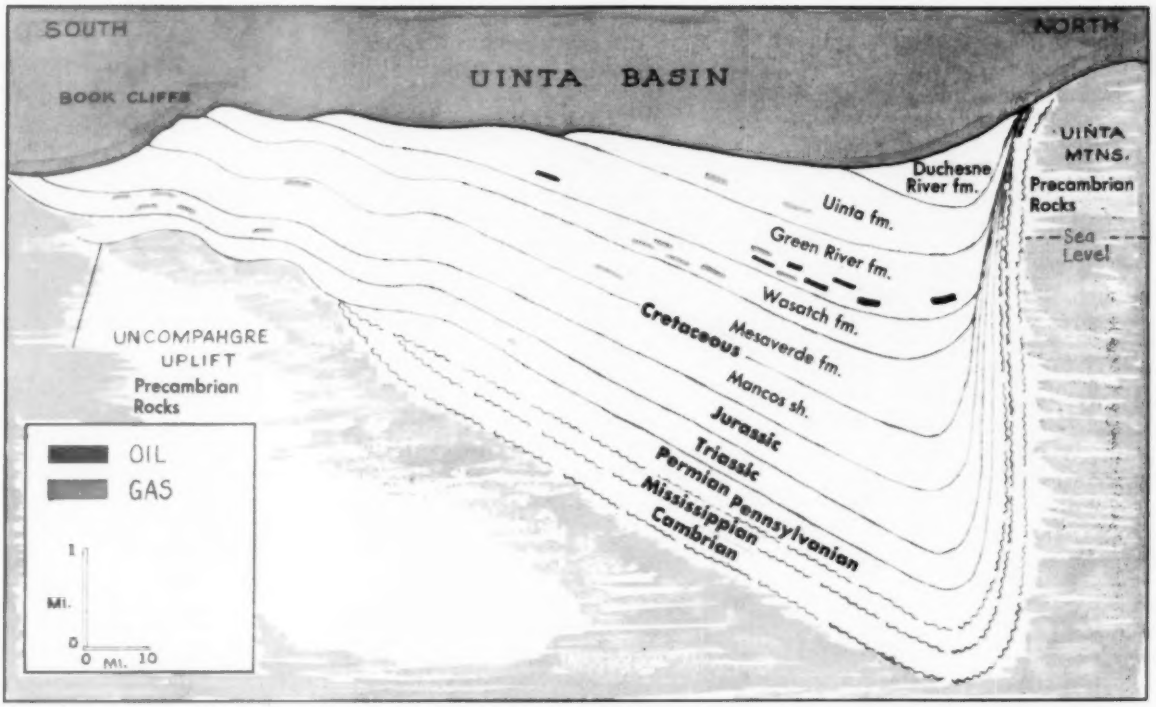

STEEP NORTH DIP occurs as the low of the Uinta basin is approached. Note the producing sections. Fig. 2.

basin and will be called the Book Cliffs-Douglas Creek arch gas area. Each of these areas contains several fields and production from several sands.

Uintah Gas Area

In 1953, El Paso drilled the discovery well in Peters Point gas field in the south-central part of the basin. The following year Continental Oil Co. discovered gas in a similar sand in the same formation 45 miles to the northeast at Chapita Wells. Since 1956, several discoveries have been made in the area of each of these wells and in the large area between.

The producing sands are lenticular and occur through an interval up to 400 ft. thick known as the Chapita zone in the middle of the Wasatch formation. To date 25 gas wells have been completed in the Chapita zone throughout an area of over 300 sq. miles. It is possible that most of this large area will be productive.

Deeper formations also offer good gas potential in this area as indicated by completions in the Tuscher and Mesaverede sands. More drilling to these deeper objectives should discover additional stratigraphic-trap accumulations.

During 1960, 21 wildcat wells were drilled in Uinta basin and 7 of these were completed as gas wells in the Wasatch formation. The producing sands range in depth from 4,100 ft. on the south to 6,900 ft. on the north as shown on the structural cross-section (Fig. 2).

The wells range up to open-flow potentials of 36 M.M.c.f.d. Some recent completions are:

- 11 M.M.c.f.d. at Mountain Fuel 1 Island unit in the western part of the gas area.
- 12,500 M.c.f.d. at Shamrock 1 Rock House unit in the eastern part of the gas area.
- 2,200 M.c.f.d. at DeKalb-Texaco 2 Uintah unit in the southern part of the gas area.

In the northern part of the gas area in 1960 Belco completed five wells on the Chapita Wells unit for initial production rates from 1,250 to 11,452 M.c.f.d. with an average rate of 4,234 M.c.f.d.

Gas from these sands is 1,000 B.t.u. or higher. Some of the Wasatch gas carries condensate. Mesaverde sands in a few wells have given up free oil on drill-stem tests, but as yet none have been completed as oil wells. El Paso-Gulf 4 Southman Canyon unit is completed in a Mesaverde sand for 4,700 M.c.f. of gas and 121 bbl. of condensate per day.

Reserves in the Uintah gas area can be estimated at present only from logs and drill-stem tests. After production has been maintained,

Stratigraphic column of eastern Uinta basin

Period	Formation	Production
TERTIARY	Duchesne River fm.	
	Uinta fm.	gas
	Green River fm.	oil and gas
	Wasatch fm.	gas
CRETACEOUS	Tuscher sands	gas
	Mesaverde sandstones	gas and oil
	Mancos shale (sandy and fractured zones)	gas and oil
	Dakota sandstones	gas
	Cedar Mountain fm.	gas
JURASSIC	Morrison fm.	gas
	Curtis fm.	
	Entrada sandstone	gas
	Carmel fm.	
	Navajo sandstone	
TRIASSIC	Chinle fm.	
	Shinarump conglomerate	oil
	Moenkopi fm.	
PERMIAN	Phosphoria fm.	oil
	Weber sandstone	oil and gas
PENNSYLVANIAN	Morgan fm.	
	Round Valley limestone	
MISSISSIPPIAN	Manning Canyon shale	
	Humbug fm.	
	Deseret limestone	
	Madison limestone	
CAMBRIAN	Lodore fm.	

more accurate figures can be obtained. Reserves of 2 trillion cubic feet in the Wasatch sands seem probable. Additional exploration will no doubt increase this amount by expansion of the area and discovery of deeper reservoirs. Mountain Fuel is offering 16½ cents per M.c.f.

Book Cliffs-Douglas Creek arch gas area. The eastern flank of the Uinta basin is marked by the Douglas Creek arch in western Colorado (Fig. 1). Most wells on the arch were aimed at Weber production similar to that at Rangely on the northern end of the arch. Gas was first found on this broad uplift in 1943. Production was from the Dakota sand in Douglas Creek field.

Exploration for Dakota gas was greatly increased in 1954 by the approval of the Pacific Northwest pipeline route along the entire length of the arch but only a few small fields were discovered.

In 1956, Phillips Petroleum Corp. 1-B North Douglas Creek unit was plugged back from the Weber and completed for 4,880 M.c.f.d. from the Castlegate sand at the base of the Mesaverde. This discovery opened an entirely new line of exploration thought on the area and has resulted in the discovery of several new shallow gas fields.

Phillips completed six wells at depths from 800 to 1,300 ft. for initial potentials of 3,750 to 19,600 M.c.f.d. Production is near the eastern edge of the Castlegate sandstone, but is localized in areas of structural closure against faults. Structurally low wells have encountered water in this sand. The gas is sold to Western Slopes pipeline for sale in the Grand Junction, Colo., area.

Recently, 27 gas wells have been completed in the Emery member of the Mancos shale. This unit consists of rather tight siltstone, fine sand, and interbedded shale. It is up to 400 ft. thick and about 800 ft. deeper than the Castlegate.

The Emery producing area includes the Douglas Creek and Dragon Trail units of Continental and adjacent lands. Drilling with air is most successful and initial potentials up to 6,500 M.c.f.d. have been obtained at depths of 1,800 to 3,500 ft.

The accumulation in the Emery appears to be controlled by westward and lateral shaling up of the member which is developed as a tongue across the middle of the Douglas Creek arch.

The southern end of the Douglas Creek arch and the Book Cliffs near the Utah-Colorado line overlie the buried Uncompahgre uplift. This large feature was a range of mountains during Pennsylvanian time and separated the Paradox basin on the south from the normal cyclic marine deposits of the Morgan formation to the north (Fig. 2).

Several northwest-trending anticlines are developed in the beds overlying the Uncompahgre uplift. Numerous gas fields have been found by drilling on these anticlinal trends which plunge into the basin (Fig. 2).

Production in these fields is primarily from stratigraphic traps in the lenticular sands of the Dakota, Buckhorn, and Morrison (see stratigraphic column). Additional production has been found in the Castlegate and Entrada sandstones in structurally closed positions.

Operators in this area include: Oil, Inc., with nine wells and one drilling in Westwater field; Sinclair Oil & Gas Co. with five dually completed wells in San Arroyo field; American Climax with ten wells in Bar-X field which straddles the state line; Gulf Oil Corp. with five wells in South Canyon field.

During 1960, 6 of the 13 wildcats drilled in the Utah portion of this area were completed as gas discoveries. Trend Oil completed its 1 Bryson Canyon unit for 15,500 M.c.f.d. Texaco and Sunray also had 1960 discoveries. Exploration plans call for several more wells in 1961.

Most of the fields are being developed on 640-acre spacing in the Dakota and deeper sands. Reserves in these sands vary from 5 to 8 billion cubic feet per well.

Dakota and Morrison gas ranges from 850 to 1,050 B.t.u. with values over 1,000 in the Utah part of the area. Gas in the Entrada carries carbon dioxide and nitrogen which lower the value to 500-650 B.t.u.

Future exploration in the Uinta basin. The new pipeline will undoubtedly cause an increase in drilling in and around the presently known gas fields. These wells should find extensions and new pays. The activity will point also to the exploratory merit of other parts of the basin. Some of the possible plays are as follows:

1. The main activity in the near future will probably be eastward and southward expansion of Wasatch, Tuscher, and Mesaverde production of the Uintah gas area.

2. At the same time there will be northward and westward expansion of the Book Cliffs-Douglas Creek gas area looking for production in Castlegate, Emery, Dakota, Buckhorn, and Morrison sands.

3. These two plays will approach each other or merge over the buried north flank of the Uncompahgre uplift and some of the wells will probably be taken to the Paleozoic. Permian and Pennsylvanian arkoses and conglomerates derived from the ancient mountains intertongue northward into marine limestones, sandstones, and shales providing attractive objectives for future drilling. Also, Mississippian and Devonian dolomites and limestones which are beveled and unconformably overlain by younger sediments offer untested potentials.

4. The western part of the basin contains over 3,500 sq. miles with a wildcat density of about one well per 120 sq. miles. The new pipeline will cross the southern part of this large area and drilling activity should increase. All of the formations and favorable stratigraphic relationships which produce in the eastern part of the basin are present in the western part. Also, additional prospective objectives exist in the rocks of most ages because of thickening or marine invasion from the west.

5. The western margin of Uinta basin is more structurally and stratigraphically complex than the rest of the basin. The units are typically thicker and undergo facies changes at the western margin. The rocks have been folded and overthrust during "Laramide" deformation and subsequently were cut by north-trending high-angle normal faults. Clear Creek gas field produces from the Ferron sand in the Mancos in one of these folds. These favorable stratigraphic and structural conditions combine to create numerous possibilities for future drilling prospects.

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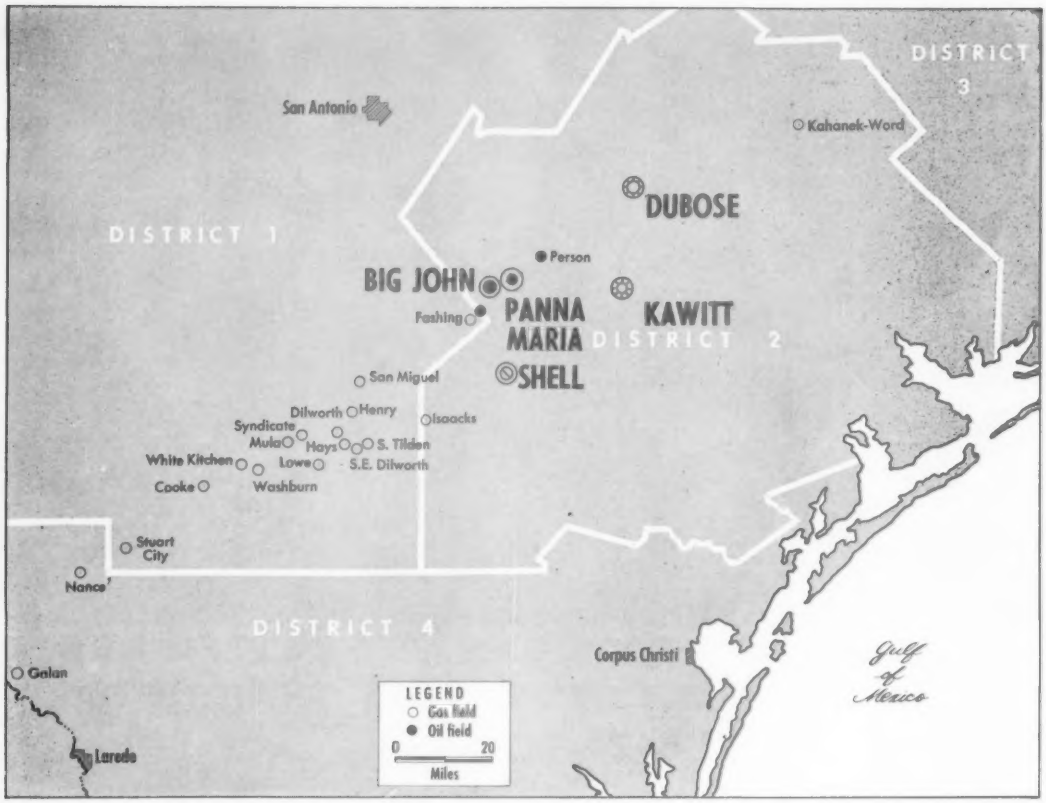


THE DEEP EDWARDS TREND now stretches across 200 miles of South Texas ranch country. Four important 1960 discoveries are shown by large circles; these are Big John, Panna Maria, Dubose, and Kawitt fields. In Bee County, District 2, Shell Oil Co. 1 O'Neal is a rumored discovery; if successful, the trend will be widened in its center. Fig. 1.

Edwards trend forges ahead

. . . and becomes a major gas reserve

BY GEORGE R. PINKLEY
Geologist, San Antonio

LAST FALL, the writer made a complete review of the developments of the Edwards trend in South Texas (OGJ, Nov. 21, 1960, p. 262, and Nov. 28, 1960, p. 112).

Since then, the area has had constant activity, and a summary of the more recent developments is now needed. The confidence of operators in the zone has been shown by the large number of deep wildcats drilled, and the resulting discoveries will pay dividends on the investment.

The producing fields have additional production history, and a compilation of sales figures adds to our appraisal of the economic status of the play. Additional geologic data have been brought to light, and better predictions can be made on the future of the trend. With the drilling of several outpost wells around the older fields, it is possible to discuss reservoir conditions with more confidence.

Permeability a factor. In earlier discussions it was pointed out that several types of structure will produce from the Edwards. A fold, fault block, or salt dome can provide the necessary closure. Now it appears that permeability plays an equally important role in providing a commercial producing rate. Several tests have been drilled which were located on structure as high as good producers, but found the Edwards too tight to be profitable. One well at Fashing, another on the Isaacks prospect in Live Oak County, one in Southeast Dilworth field of McMullen, and one in the Cooke-White Kitchen area of La-Salle have verified this conclusion. As a result, an operator must be prepared to drill more than one test on a structure. As drilling costs have gone down, this will not deter development of any anomaly of size along the trend.

An analysis of the sales of gas from some of the fields also bears

out the theory that there is a considerable variation of permeability within the reservoirs. While method of completion and market demand is a factor, the gross sales vary considerably in local areas. One lease at Fashing can be used as an example. The sales in 1960 from this tract were as follows:

No. 1	904,480 M.c.f.
No. 2	954,296 M.c.f.
No. 3	522,889 M.c.f.
No. 4	741,718 M.c.f.
No. 5	724,227 M.c.f.

These wells are approximately 2,400 to 3,300 ft. apart and the figures are from the same zone.

Wells on the adjoining lease yielded the following:

North offset to No. 1	517,142 M.c.f.
North offset to No. 2	460,509 M.c.f.
North offset to No. 3	465,032 M.c.f.

Wildcatting ahead. Lease activity has been such that nearly all the acreage on the trend has been purchased and in some areas the prices have risen to as high as $50 an acre. Some of the larger operators have taken a strong acreage position and will need to do extensive seismic work to determine the value of their holdings. With average luck in locating structures one can predict a continued program of deep wildcat drilling for the trend.

Geologic knowledge of subsurface conditions is increasing and as optrators become less stringent in holding back release of key logs, it will be possible to construct isopach and paleogeologic maps which will be of great aid in finding local structure. At present, it appears that we are dealing with a complex pattern of folding of late Cretaceous age, complicated by Eocene and later faults. Considerable truncation is present on the older structures and serves to make seismic interpretations difficult. From well data in Bee, Karnes, and DeWitt counties, it is probable that the Midway-Taylor zones are thinner than in central McMullen County, and that the thick Georgetown - Kiamichi wedge is also missing. This brings the Edwards to a shallower depth and widens the area of possible play. A well now started at North Pettus, Union Producing Co. 6 NPU-Ray, will be the next important test. Projected to 13,000 ft. it is on the crest of a prominent Wilcox sand structure and could find the underlying Edwards equally high. If productive, it will encourage the drilling of numerous old fields.

In summary, one can say that the Deep Edwards play is progressing properly, though slowly, as one can expect from the cost of drilling and the scarcity of good deep subsurface data. The play is too expensive for the smaller independents and the stiff proration in Texas has not encouraged some of the major oil companies.

As a future source of profitable oil and gas reserves, the Edwards is increasingly important for South Texas and gives encouragement for the long-range operations in the district. It has the potential of becoming a major reserve, and could easily be the largest producing zone in the area.

Four New Fields

Careful seismic studies have been mainly responsible for the discovery of four new producing areas, three of which are undergoing additional development. Discovery data on the new fields are as follows:

Big John. In Karnes County, between Fashing and Falls City. Opened in November 1960 by Bright & Schiff 1 Kunkel. Potential was 265 bbl. per day, 38° oil, 30% water on ¼-in. choke, GOR 1,500/1, TD 11,495 ft., perforated 10,940-50 ft.

One additional producer has been completed and two wells are now drilling. There is a large gas cap present and the first well in the area, Bright & Schiff 1 Rohan, had excellent gas showings in the Buda. Accumulation caused by folding along the Hobson fault pattern.

Dubose. In southeastern Gonzales County, 9 miles south-southeast of Smiley. Opened by Superior Oil Co. 1 Dubose, now waiting on potential. Tested 2.3 M.M.c.f. gas with 57 bbl. condensate, 51° gravity, 31% water. Total depth reported 15,574 ft. (?), perforated 12,064-74 ft. and 12,130-38 ft. There is no nearby well control, but seismic data show a complexly folded and faulted area. Cores and test data suggest a better potential for other wells in the area.

Kawitt. On the Karnes-DeWitt county line, 2 miles southwest of Nordheim. Discovered by Texas Eastern Transmission Corp. 1 Garbe in November 1960. TD 14,837 ft. perforated 13,881-13,910 ft., potential 8.6 M.M.c.f. gas, condensate 55° gravity. One well now drilling to the southwest reported slightly higher on structure, while a dry hole to the north has partially indicated limits of area. Structural data are lacking except that shallow Wilcox contours (−7,000 ft.) offer no indication of uplift. This field is 13 miles downdip from Persons and is 3,000 ft. lower structurally.

Panna Maria. In Karnes County, 4 miles east-southeast of Falls City, just southwest of Persons field. Discovered by Standard Oil Co. of Texas in October 1960, now has confirmation well drilling. It is at same subsea datum as Persons field and could be part of that field. It produced 98 bbl. per day of 46°-gravity oil, with GOR 11,220/1 on 18/64-in. choke. TD is 11,450 ft. and perforations at 10,943-47 ft. Sales of oil in 1960 totaled 3,163 bbl.

Production Records

Webb County. Lack of market and the drilling of several wildcat dry holes has kept development down in the county. Most of the land in the trend is in large ranches and future drilling will be slow.

LaSalle County. Drilling of several outpost wells and continued production has kept this county active. No new discoveries were made in 1960. Field production is as follows:

	Wells	Production (M.c.f.)
Cooke	5 (2 SI)	804,440
Stuart City	10	2,320,831
White Kitchen	2	284,525
Washburn	2	1,276,826

McMullen County. Drilling of outpost wells was active in 1960. There are three new wells at San Miguel and two at South Tilden. Southeast Dilworth field has two completions, one drilling and one dry hole since the last report.

A new sulfur-recovery plant is in operation at South Tilden and the original sulfur-removal unit is at full capacity. Flow from some of the wells is being reduced as new completions crowd existing facilities.

	Wells	Production (M.c.f.)
Mula Pasture	1	102,632
Dilworth Dome	1	627,341
Dilworth SE.	5	3,564,910
Tilden SW.	1	241,840
Tilden, South	4	1,514,697
San Miguel Creek	3 (1 SI)	1,190,150

Atascosa County. Minor development at Fashing field took the form of an additional oil well on the northeast end, and two dry holes, one across the fault on the northeast and one on the south edge, have left this field in a relatively completed stage.

Pressures in part of the field are beginning to fall as a result of this quick withdrawal, but those operators selling gas have had the satisfaction of a relatively quick payout on a large investment.

Oil production has been minor and liquid recovery low. No figures are available on sulfur sales, but gas market has reached a very high figure. Sales for 1960 were:

	Wells	M.c.f.
A zone	33 (3 SI)	22,248,564
B zone	25	22,756,875
Gross recovery from the field to date is placed at		101,093,000

Some of the wells have had unusual sales as a result of dual completions. Four wells sold over 2 billion feet last year, while another 14 sold over 1½ billion.

Lavaca County. Kahanek-Word field had one dry hole recently completed. There will probably be additional drilling in the near future.

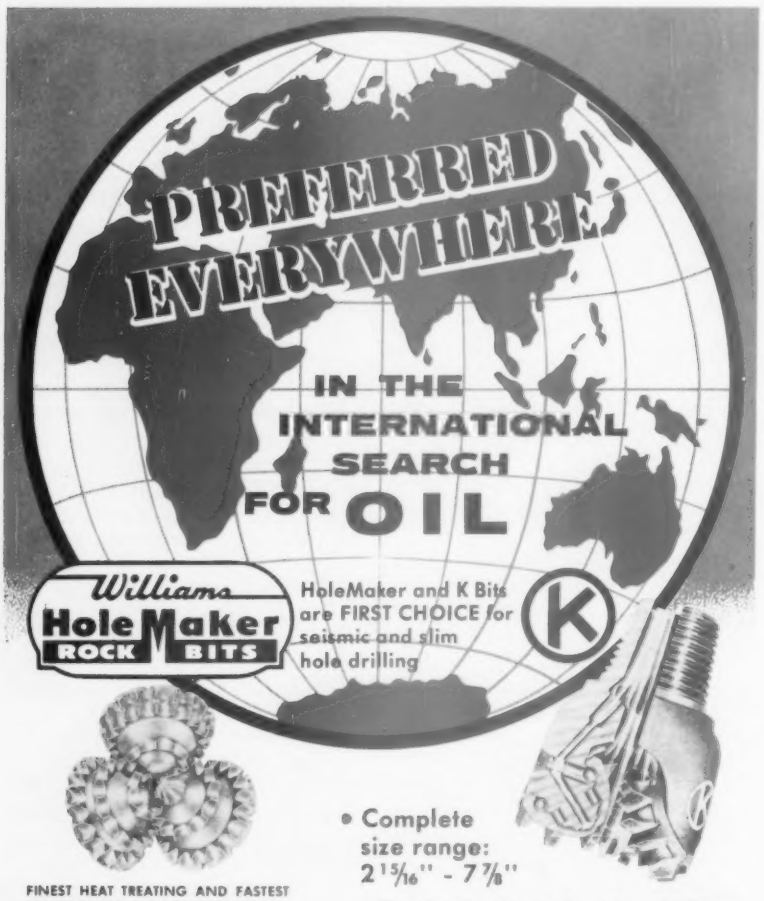
Karnes County. Persons field has been the scene of an intensive deep drilling program during the past year. There are now 41 oil wells and 1 gas well. There have been three dry holes and six rigs are running. Shell Oil Co. drilled two deep tests, 1 Jaskinia to 13,685 ft. and 1 Kainer to 13,827 ft. The former was dry, the latter completed as an Edwards producer. Both had showings in lower zones and were thoroughly tested.

Production from the upper Edwards in 1960 was 311,044 bbl. from 26 wells. The lower zone produced 78,546 bbl. from eight wells. Gross production from the field to date is 441,281 bbl.

And in Bee County. One of the most promising wells in the district is in the process of testing and by the time this report is printed, it will probably have been completed as a new and very important discovery.

This is Shell 1 O'Neal at Pawnee in northwestern Bee County. The operators have released no definite news on this well but rumors have been flying sky high, and royalty prices have soared equally. The newspapers have printed a little data, which has a logical sound, and gossip has released formation tops, very little in the way of positive evidence for construction of a geologic map.

The present story is that the top of the Edwards is at 13,000 ft. subsea, with good showings and a drillstem test some 1,600 ft. deeper gives hopes for a new deep horizon for the district. The well is reported running liner at TD 17,004 ft., with a 7-in. protection string at 14,520 ft. If productive, this will widen the producing area of the Edwards trend to around 13 miles which is about the same width as in McMullen, DeWitt, and Karnes counties. The structural position, assuming our data are correct, will either flatten the regional dip considerably or place the well on a major structure with a very large thinning of section. Previous isopach and regional structural contours had indicated that the Edwards would have been at least 1,000 ft. deeper.



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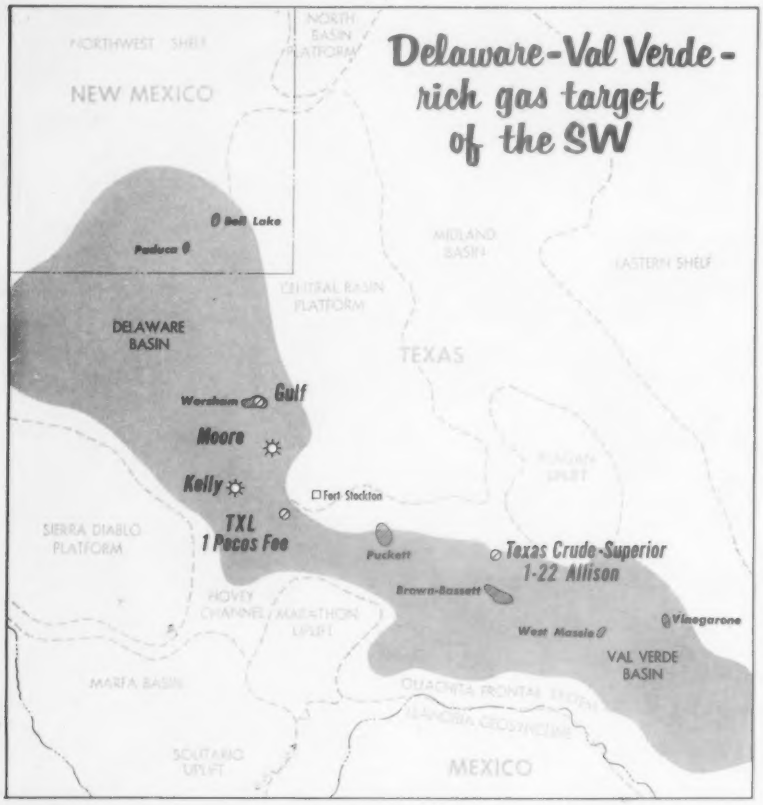

RECENT OIL AND DEEP GAS DISCOVERIES that have projected the Delaware-Val Verde basin province into today's exploration spotlight are shown here. Deep targets and expensive drilling are offset by the prospect of unusually rewarding finds in a multiplicity of pays throughout this vast region.

Where gas search is

Deep, expensive, and rewarding

Delaware-Val Verde is a business-type gamble

BY W. D. THORN
Independent Operator, Midland, Tex.

TEN YEARS AGO the possibility that West Texas and southeastern New Mexico might become a major source of nonassociated natural gas was generally regarded as rather remote. The great oil fields of the Permian basin were providing ever-growing and valuable supplies of casing-head gas, but the idea that this region might become the New Frontier of the natural-gas business was entertained by few people, if any.

Ten years ago, of course, the production and transmission of gas was just getting into its stride. Gas found in this area generally had no market and even where a market existed the price was not too attractive.

Gas targets materialize. As the search for new oil reserves was pushed slowly into the Delaware and Val Verde basins westward and south of the Permian basin oil fields, it was established that the Pennsylvanian, Devonian, and Ordovician formations, so productive of crude oil in the Permian basin area, were very gassy in the deep and expensive wells in the Val Verde-Delaware region. Coincident with the realization that great gas fields probably existed throughout the Val Verde - Delaware, the market demand for gas—and gas reserves—skyrocketed.

This surging demand furnished the incentive for the big gas-transmission companies to build lines into the new areas. Permian Basin Pipe Line Co., subsidiary of Northwest Natural, tied into Puckett field of Pecos County, where Phillips Petroleum Co. had registered Devonian and Ellenburger gas strikes at the 14,000 to 16,000-ft. level. The significance of the Puckett strike did not register overnight on most of the oil and gas companies in West Texas, but as time passed and the field grew larger and larger and the gas reserves bigger and bigger, everyone seemed to want to get in on the act. Few operators stopped to ponder over the fact that Phillips had spent some 20 years of geological and geophysical work and millions on exploration in the area before getting any return on the play. It was the first major discovery in the Val Verde basin-Sheffield channel area.

Not long after the Puckett discovery, Continental Oil Co. found Pennsylvanian and Devonian gas in Bell Lake field, Lea County, New Mexico, located about 150 miles northwest of Puckett field and in the northern part of the Delaware basin. Then, a couple of years later, in 1957, Magnolia (Mobil Oil Co.) found Ellenburger gas in Brown-Bassett field, some 50 miles southeast of the Puckett area. Meanwhile, Phillips had established Strawn gas production in the Vinegarone field in northeastern Val Verde County and Magnolia had found a little and very deep Ellenburger gas in the Massie West field, same county, both in the Val Verde basin.

While this deep pre - Permian successful drilling was being done, Gulf Oil Corp. had found a substantial gas reservoir at the shallow 5,000-ft. level in Worsham field in

eastern Reeves County, and in the Delaware sand of Bell Canyon age. This shallow find was made incident to shallow stratigraphic drilling of the Worsham prospect, on which Gulf at this time is drilling a deep Devonian wildcat.

Pipelines arrive. Development of the Worsham - Delaware gas field was held to nine wells over a period of 5 years while waiting on a market. Last fall Transwestern Pipe Line Co.'s big line from West Texas to the Pacific Coast tied into the field and since then a number of new wells have been completed. The company's take in this field appears to be tied in with demand on the West Coast. For a couple of months this past winter, Transwestern bought approximately 75 M.M.c.f. per month, per well, then dropped down to 35 M.M.c.f. Price here is 16 cents per M.c.f. It is an attractive economic deal for the producers.

The Delaware sand formation, found in structural position near the east side of the Delaware basin, rather than in stratigraphic traps as farther west, offers opportunity for gas and/or oil production with the result that much drilling currently is being done along a general trend northwest-southeast from Worsham field, and with considerable success.

The shallow formations in the Val Verde basin portion of the deep gas play thus far have shown no rewards equivalent to the rich and shallow sands found during the past few years in the Delaware basin. Willingness of most companies to farmout for shallow tests, in hopes production will perpetuate leases for future deep exploration, has resulted in discoveries of very prolific Delaware sand oil fields. Most recent example is Paduca field, southwest Lea County, New Mexico, where Tennessee Gas Transmission Co., Texaco Inc., Continental and Perry R. Bass are completing 4,900-ft. wells with reserves estimated at 500,000 bbl. per well.

Discoveries such as Paduca may be regarded as a byproduct of the search for deep production in the Delaware basin. The knowledge that such juicy finds may be found enhance the value of wildcat acreage and add to the romance of the really deep play now under way.

Gas Drilling Runs High

High drilling costs do not seem to be any deterrent to the operators looking for 15,000 to 20,000-ft. gas pays in the Delaware-Val Verde basin exploration campaign. Chief problem of those operators who want to look for the deep pays seems not to be financial but mechanical. Estimates from well-informed executives on the profit possibilities of a deep gas strike range from "fabulous" to "$25,000,000 net per well."

This means that for even the real deep holes, 17,000 ft. or so and deeper, the profit may be 25 or 30 to 1. And considering that you start off with 1 million dollars or more, the potential profit is indeed great.

Inquiries directed to several companies and drilling contractors reveal that for a wildcat well hoping to reach the Ellenburger formation at a depth of approximately 18,000 ft., the budgeted cost will be in the neighborhood of $1,250,000 for a completed well.

The actual cost of course may be a little bit less but is more likely to be considerably greater, due to the many drilling hazards of lost circulation, pipe failure, crooked holes, etc. When one executive geologist was questioned about the cost of one of these deep wells he replied that, "Anybody who wants to drill one of these deep holes is in the same category as a man who wants to buy a yacht. He shouldn't care what it costs!"

Helping to substantiate this viewpoint is the report that Mobil Oil Co. spent $800,000 for drilling mud alone, after reaching total depth, in its 1 Kathleen Moore, deep Pecos County discovery which made 102 M.M.c.f. of gas daily from Pennsylvanian perforations at 15,051-47 ft. Since the original completion of this big strike last year, its abnormal bottom-hole pressure of 12,590 psi. is reported to have caused tubing leaks and workover measures which have cost the operator another half-million dollars.

The bottom-hole pressure found in the Mobil well is regarded as abnormal for West Texas, but it poses a problem for other wildcatters drilling wells toward the same objective in the Delaware basin. Expensive precautions in high-pressure equipment must be taken.

In the Val Verde basin, the Ellenburger has been reached by the drill innumerable times. In the deeper part of the Delaware basin this objective has not yet been touched nor has the Devonian. Chief obstacle appears to be the many porous and high-pressure zones encountered in the Pennsylvanian formation, with accompanying blowouts and loss of circulation.

Dollars in a hole. One of the new deep holes being drilled in the Delaware basin, in the Pecos County area southwest of Fort Stockton, and in an area where no one knows exactly where the Ellenburger will be reached, is set up to drill to 18,500 ft. It is a joint operation of three companies and the objective is the Ellenburger. This well furnishes, for drilling-cost purposes, an accurate estimate of what any deep wildcat test in the area at this time faces.

The drilling contractor has taken the job on a footage basis down to 13,800 ft. It is planned to run 400 ft. of 26-in. casing to 400 ft., 4,500 ft. of 13⅜-in. to 4,500 ft., and 9⅝-in. to 13,800 ft.

The 26-in. surface string is 94-lb. per ft. line pipe, plain end, with slip-on collars and welded as it goes in the hole. Estimated cost, approximately $5,000.

The 4,500 ft. of 13⅜-in. casing will be a combination string of 72-lb. N-80 and 68-lb. J-55 casing. It will cost approximately $45,000.

The long string of 9⅝-in. pipe to be set at 13,800 ft. will be 53.5-lb. P-110 grade casing and will cost approximately $100,000.

After the string of 9⅝-in. pipe is cemented, the hole will be drilled by the contractor on a day-work basis. It is estimated by the joint operators that this casing point will be on top of the Strawn (Pennsylvanian zone).

When the hole reaches total depth it is planned to run a string of 7-in. casing, at an estimated cost of $100,000.

The specially ordered pipe and fittings for this well, below the 13⅜-in. casing string, including the blowout - preventer equipment, will be mill-tested to 10,000-psi. w.p.

Cost of drilling mud and water required to drill this hole is estimated at $250,000. This figure is only a guess, as the actual cost of

these items will depend on conditions found as the hole progresses. And very difficult drilling conditions can develop even though the project is a dry hole.

In many parts of the Delaware-Val Verde basin all prospective pay formations, including the Ellenburger, can be tested at depths above 14,000 ft. One of the new discoveries, 1-22 Allison, in northeastern Terrell County, being drilled by Texas Crude and Superior, stopped at total depth 13,177 ft. after finding gas in the Ellenburger, Fusselman, Devonian, Mississippian lime, Penn Detrital, and Strawn sand. The Strawn showed considerable oil on drill-stem tests; however, it is reported to be quite gassy on production tests now under way. This well cost approximately $350,000 before moving on a completion unit, which at this writing had been at work for 8 weeks at a cost between $750 and $1,000 per day. A triple-pay completion may be tried. It was air-drilled down to 10,265 ft., with mud on down to total depth.

The three big pipelines gathering gas from the big gas fields are Permian Basin Pipe Line Co., El Paso Natural, and Transwestern. Price being paid is reported to be 16 cents per M.c.f. Take from various fields varies with potentials and line capacities and seasonal demand. Where all factors are favorable and liquids are extracted from the gas, revenue per well runs up to $25,000 to $30,000 per month.

Outlook Unlimited

It is reasonable to assume that the present high interest and very active wildcatting campaign now underway in the Delaware - Val Verde basin, and to some extent in its southwesterly offshoot, the Marfa basin, will continue into the foreseeable future. Surface structures, subsurface structures and geophysical prospects abound. A lot of the subsurface geology is theory and guesswork, and some real hot seismic prospects have been far off the beam. Despite the drilling hazards, the expensive leases, and the uncharted geological depths, the men who control the money are turning it loose in huge amounts in high hopes of a big payoff from the business-type gamble for gas.

There is plenty of space to work in. The search for gas, and most of it toward objectives at 10,000 feet and below, spreads from Eddy and Lea counties at the north end of the Delaware basin, southward through Culberson, Reeves, Loving, Winkler, Ward, on through Pecos County into the Sheffield channel and on southeastward into Val Verde basin counties of Terrell, Crockett, Val Verde, Edwards, and even portions of Kinney and Bandera counties. Some activity is under way in Brewster and Presidio counties, in the Marfa basin and any good production found here will jump the play right across the Rio Grande River into Old Mexico.

Should this happen, and if any driller ever finds the bottom of the Delaware basin, the age-old concept that a hole drilled deep enough would wind up in China may be completely upset by the discovery that a hole drilled deep enough to reach China actually may come out in Old Mexico.

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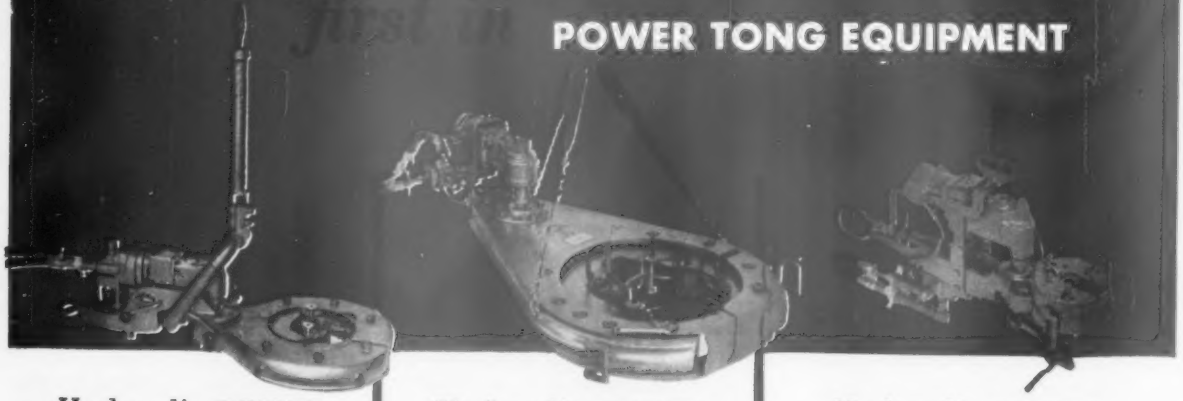

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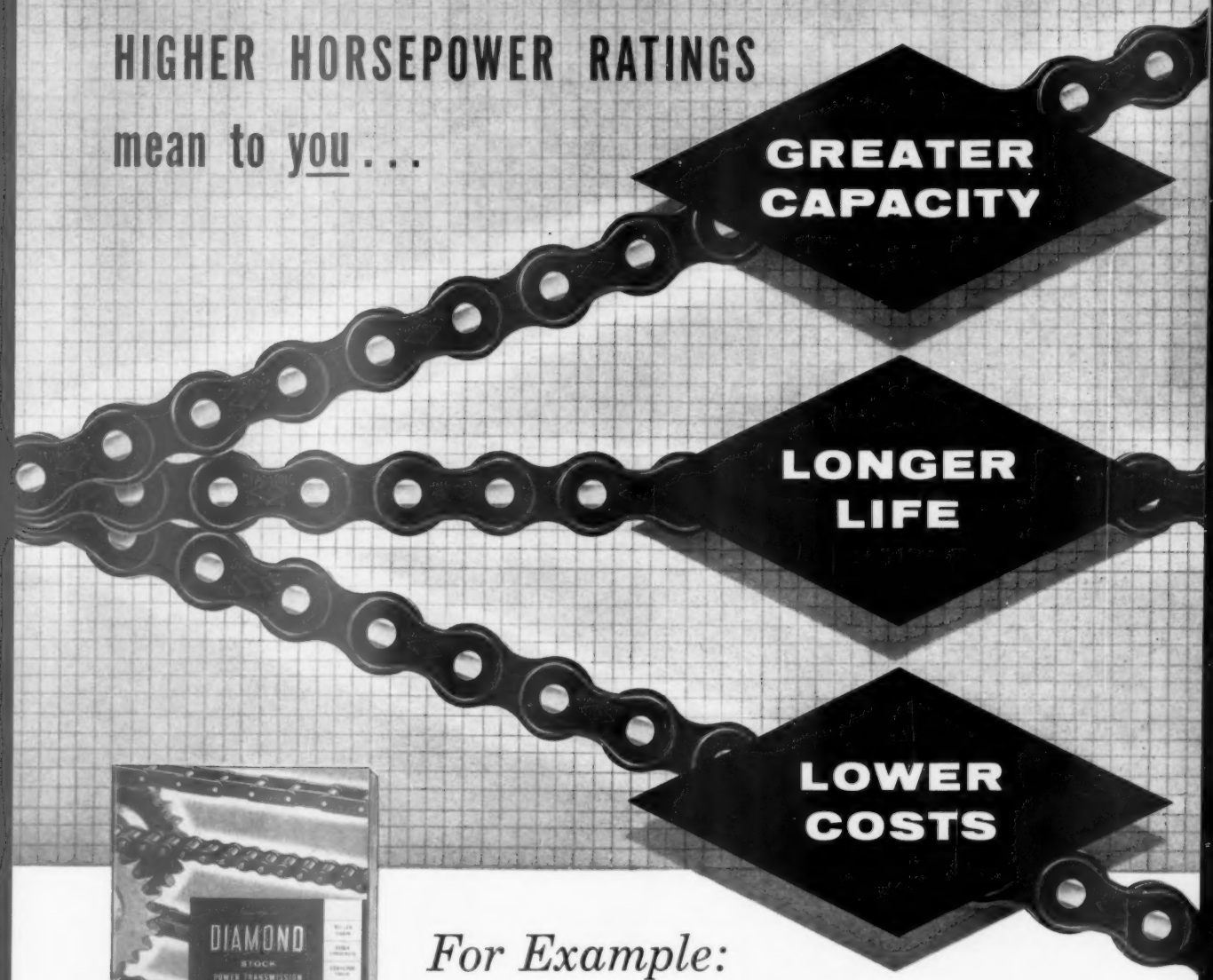

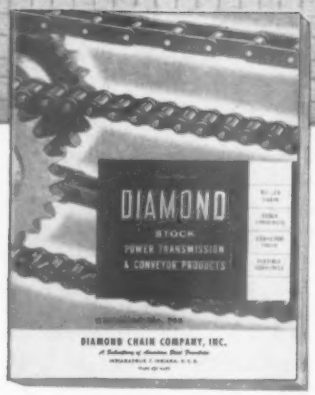

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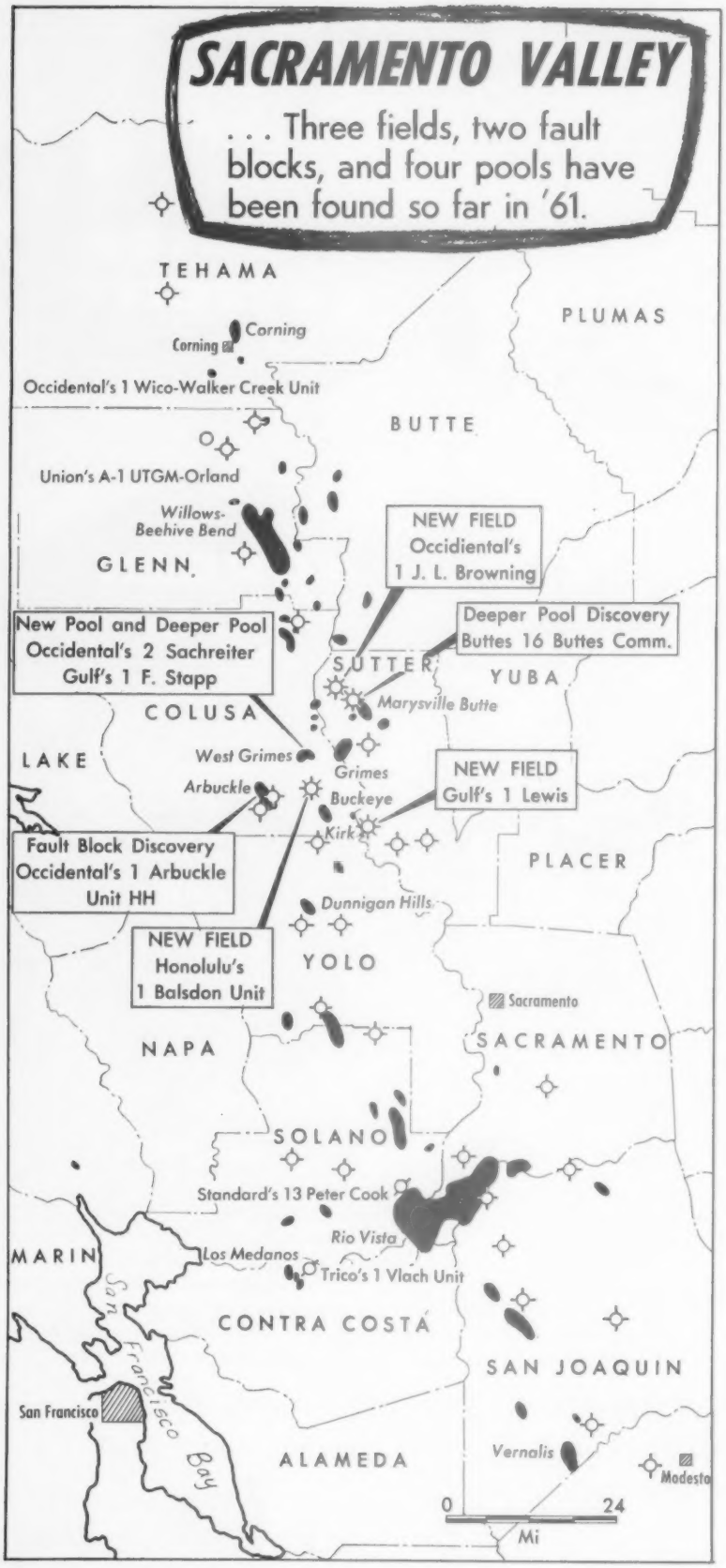

IN CALIFORNIA:

Sacramento

One geologist predicts: Big future of the valley is in the deep zones between 10,000 and 15,000 ft.

BY CARL J. LAWRENCE
West Coast Editor

CALIFORNIA'S Sacramento Valley is continuing to earn its reputation as a growing gas province.

During the first 3 months of 1961, the valley has turned up three new fields along with one fault-block discovery and three new pools.

Two counties—Sutter and Colusa in the middle of the valley—have grabbed all the significant successes thus far this year, but drilling has been going on throughout the entire 205-mile-long valley.

Sutter and Colusa counties probably will provide many significant wells during the remainder of the year as companies push their search for the pre-Kione "F" zone in the Upper Cretaceous. But some other areas are expected to share the spotlight with Sutter and Colusa.

Several wildcats undoubtedly will be drilled in the delta area of Sacramento and Salona counties. These will test the Paleocene sands that turned up some discoveries in 1960. The northern Sacramento Valley counties of Glenn and Tehama will also see some additional drilling during the remainder of 1961 and several holes probably will be drilled in the extreme southern portion in San Joaquin County.

Successes. Two of the valley's three 1961 discoveries were made in Sutter County during March. The other is a Colusa County find made in February.

The Sutter discoveries are Occidental Petroleum Corp.'s 1 Browning in Section 19-16n-1e. The "F" zone well was testing at the time of this writing, but is scheduled to be

Valley turns up more gas strikes

completed at about 6,800 ft. The Browning well is 2¼ miles northeast of Butte Slough gas field, a one-well field and nearest production.

Gulf Oil Crop. is completing its 1 David S. Lewis in Section 23-13n-1e about 2 miles south of Kirk field in Sutter County. Gulf took the well to 9,200 ft. During a drill-stem test at 8,262-74 ft., the well flowed at the rate of 3,570 M.c.f.d. through a ¼-in. choke with a flowing pressure of 1,970 psi.

The year's third discovery is Honolulu Oil Corp.'s 1 Balsdon unit in Section 34-14n-1w in the southern portion of Colusa County. The Honolulu well was completed in a 20-ft. section of the Forbes sand at 9,576-96 ft.—the deepest production in the valley.

Gulf, one of the valley's biggest leaseholders and the most active major so far this year, owns one of the two new pool discoveries in West Grimes field, a 1960 discovery which may develop into one of the valley's biggest fields. Gulf's 1 F. Stapp was completed in the "F" zone at 6,968-7,022 ft. This is shallowest production in the four-well field.

Occidental's 2 Sachreiter also produced a new pool in West Grimes. It flowed from 7,795-7,810 ft.

The West Grimes discovery well, Occidental's 1 Sachreiter, produces from 7,652-77 ft. The fourth well in the field, Gulf's 1 C. B. Stoddard, has a 30-ft. pay beginning at 7,662 ft.

Some geologists believe West Grimes field may be linked eventually to Grimes, which is 5 miles to the east in Sutter County. Drilling to date indicates the field is a combination of structural-stratigraphic traps, but additional work will have to be done before any definite proof shows up to link West Grimes and Grimes.

Gulf and Occidental have the only completions to date in West Grimes, but Patrick A. Doheny, Los Angeles independent, is expected to complete his 1 R. M. Farmsworth, which had a show at both 6,952-87 ft. and 7,008-33 ft. The Doheny well is ½ mile east of the 2 Sachreiter.

Occidental has five wells planned this year in West Grimes. The first of the five, 4 Sachreiter, has been spudded in the south ½ of the southwest ¼ of Section 4. This will be a 9,500-ft. test of the "F" zone. Occidental also has staked location for the 4 Sachreiter in Section 33-15n-1w. The other three locations will be determined by what turns up in the first two stepouts.

Several wells also will be drilled in Grimes field this year in an effort to prove up more acreage. Cameron Oil Co. and Atlantic Oil Co. are the two principal operators in Grimes.

Among the important wells completed in Grimes so far this year is an 8,121-ft. dry hole drilled by Atlantic in Section 36-15n-1e. This is the only dry hole drilled in the Grimes area. It is 2½ miles southeast of the field discovery well.

Neither Gulf nor Occidental has announced any additional plans to drill stepouts to the Browning and Lewis discoveries, but undoubtedly both will do additional drilling in these Sutter County finds during the remainder of the year.

Both also are expected to do additional drilling in the Arbuckle and Kirk areas of Colusa County. Occidental has awarded a contract to drill its K-2 Zumwalt 2½ miles northeast of Kirk, which was discovered by Gulf last year.

Shell Oil Co. and Standard Oil Co. of California may also step up their drilling in the valley this year. Both have drilled significant deep tests in Solano County—in fact, both wells went below 15,000 ft. Shell's 1 Peterson in Section 32-5n-1e in the Denverton Creek area was completed as a dry hole at 15,001 ft. Standard of California

1961's Key Wells in the Sacramento Valley

County	Field	Operator, Well
New Fields:		
Sutter	West Butte	Occidental 1 Browing
Sutter	Lewis	Gulf 1 David S. Lewis
Colusa	College City	Honolulu 1 Balsdon Unit
Fault Block Discoveries:		
Colusa	Arbuckle	Occidental 1 Arbuckle Unit HH
New Pools:		
Sutter	West Grimes	Occidental 2 Sachreiter
Colusa	West Grimes	Gulf 1 F. Stapp
Colusa	Marysville Butte	Buttes 16 Buttes Comm.
Other Significant Wells:		
Colusa	West Grimes	Gulf 1 C. B. Stoddard*
Colusa	Arbuckle	Occidental 1 Arbuckle Unit U*
Colusa	Kirk	Gulf 1 Goff-Erdman†
Solano	Liberty Island	Reserve 3 Liberty Farms-Reynolds†
Sutter	Grimes	Atlantic A-1 Frye Unit†
Sutter	Grimes	Cameron-McElroy 1 Grimes Operating Unit 9*

*Extension †Discovery Offset

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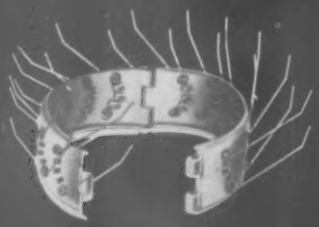

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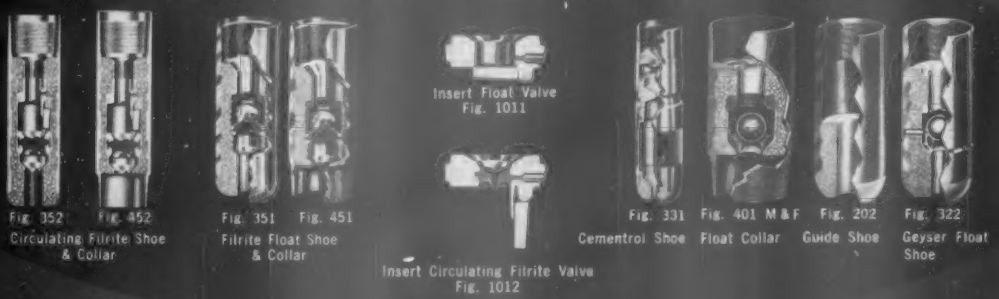

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had taken its 13 Peter Cook in Section 12-4n-2e to 15,056 ft., but has no results. At 15,056 ft. the Peter Cook was the second-deepest well drilling in California, topped only by a 15,540-ft. well Shell is drilling in the South Piru area of Ventura County.

Dry holes. The valley's three wildcat discoveries during the first quarter of 1961 are the result of 25 wildcats drilled, which gives the explorers a 1-to-8 success ratio.

A county-by-county breakdown shows this wildcat ratio:

Colusa, 1 for 1; Glenn, 0 for 3; Sacramento, 0 for 2; San Joaquin, 0 for 5; Solano, 0 for 3; Sutter, 2 for 6; Yolo, 0 for 3; and Tehama. 0 for 2. This excludes the fault-block and pool discoveries made this year.

On a footage basis, these 25 wildcats totaled 172,246 ft. or an average depth of 6,889 ft. This average depth reflects the deeper tests being drilled into the "F" zone. This drilling has been held back in the past due to economics. But today's wellhead price of 30 cents an M.c.f. is making the deeper "F" zone wells worth drilling.

This trend toward deeper exploration in the valley also shows up when the wells are classified by depths. Of the 25 wildcats drilled this year, 13 went below 7,000 ft., 9 below 8,000 ft., and 6 below 9,000 ft. This is excluding Standard of California's 15,056-ft. 13 Peter Cook.

The most wildcat hole drilled to date in '61 has been in Sutter County, which boasts a total of 49,490 ft. Second is San Joaquin County with 29,331 ft. and third is Solano County with 28,507 ft. Other total footages by county are: Yolo, 23,597; Glenn, 15,336; Sacramento, 10,354; Colusa, 10,000; and Tehama, 5,631. Both of the Tehama wells are north of Corning, which generally is considered outside the valley but part of northern California's gas play.

One geologist whose company is among the more active Sacramento Valley drillers predicts the big future in the valley is in the deep zones between 10,000 and 15,000 ft. Just how close his prediction comes to the target may be learned later this year as the deeper drilling play gains momentum.

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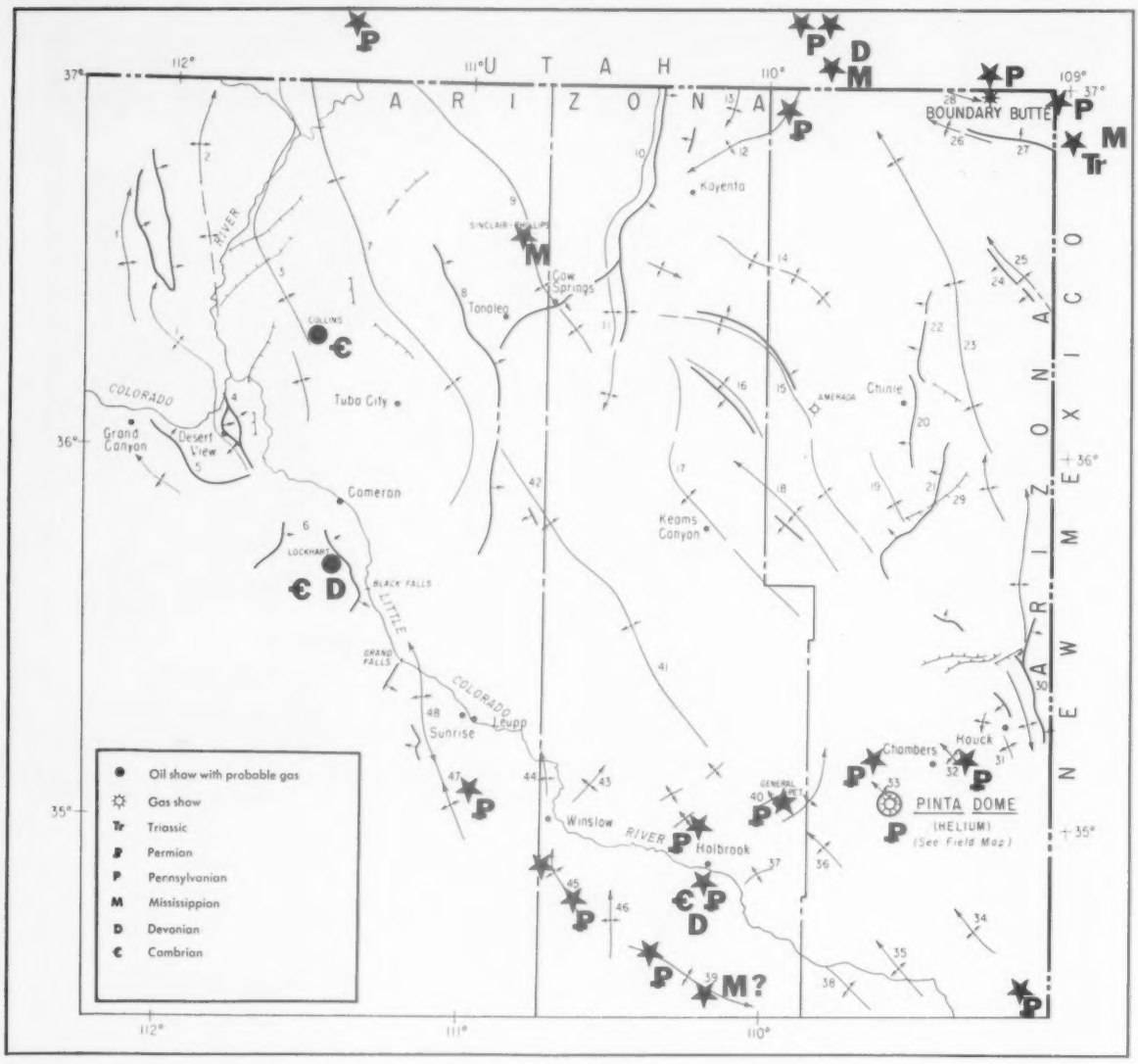


Black Mesa basin—It's a prime

Gas target for tomorrow

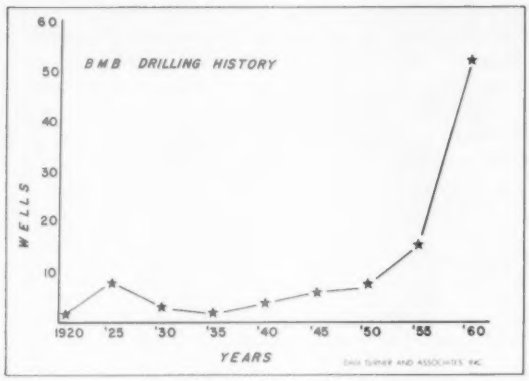
BY DANIEL S. TURNER
Denver

BLACK MESA BASIN covers essentially the entire northeast quarter of the State of Arizona. A southern limit may be defined by the Mogollon Rim with the Grand Canyon on the west, the Utah-Arizona state line on the north, and the Arizona-New Mexico line across the top of the Defiance uplift on the east defining the other basin limits. The basin is a structural unit dipping inward toward a central focal point marked on the surface by the Cretaceous mesas within the Hopi Indian Reservation.

Hopi Indian lands occupy an island in the central part of the Navajo Indian Reservation which covers all of the low lands below the Mesa flanks. The Black Mesa basin

GAS AREAS and anticlinal trends of Black Mesa basin are indicated on the map at the top of the page. The ages and locations of gas shows and production are marked. More than 55 known structural features are mapped. Fig. 1.

BLACK MESA BASIN encompasses the northeast quadrant of Arizona. Fig. 2.



DRILLING HISTORY of Black Mesa basin evidences the recent accelerated interest in this part of the state. Fig. 3.

is like an archery target wherein the Cretaceous, Mesa Verde, and Mancos formations form the bull's-eye in the central part of the basin, surrounded concentrically by outcrops of the Jurassic, Triassic, and each of the Paleozoic systems except Ordovician and Silurian, outward to the Mogollon Rim south of the Little Colorado River.

Surrounding Gas Occurrences

Numerous gas fields are known in the vicinity of the Black Mesa basin, located principally around the north and east rims as defined in the foregoing description. The San Juan basin of New Mexico is gas productive as close as Hogback and Rattlesnake fields west of Farmington. Bita Peak and Boundary Butte East, in the extreme northeast corner of Arizona on the north end of the Defiance Uplift, are the principal producers of flammable gas within the state.

Across the north line of Arizona, Boundary Butte and Desert Creek fields in Utah are gas productive with extensions of the gas-producing reservoir protruding south into Arizona. The presence of helium gas in all of these fields is of particular interest for the exotic gas potential of the Black Mesa basin. Helium is rapidly becoming the target for renewed exploration activity (OGJ, Feb. 20, 1961, pp. 194-199).

History of Drilling

At the present time slightly more than 100 wells have been drilled within the defined limits of the basin, which by statistical analysis shows approximately one test for each 250 sq. miles. A vast area of 25,000 sq. miles remains virtually untested because of the concentration of drilling in two major localities: Four Corners and Holbrook areas.

Among the more than 100 wells drilled in the basin, 32 tests, or approximately 30%, have had some indications of gas. Each system with significant areal distribution, can boast of a show of gas somewhere within the basin rim. Fig. 1 depicts the geographic distribution of gas indications or productive fields. These indicated areas of gas shows are identified in Fig. 1 with a systematic symbol for that part of the section from which gas was reported. A summary of the stratigraphic occurrence of gas shows is given in Table 1.

TABLE 1—STRATIGRAPHIC OCCURRENCE OF GAS SHOWS

System	Number of Gas Shows Reported	Area
Triassic	1	Four Corners
Permian	16	Holbrook Mogollon Slope
Pennsylvanian	10	Four Corners Southwestern
Mississippian	3	Biklabito Dome SE Utah Cow Springs
Devonian	3	Holbrook Cameron Southern Utah
Cambrian	3	Holbrook Cameron Tuba City

Analysis of the distribution of points in Fig. 1 points out the concentration of tests in the southern zone as well as the Four Corners region of the basin. Remaining points are scattered very much around the structural rim of the basin, leaving a vast area from the Defiance uplift to the Grand Canyon with relatively little exploration effort.

Most of these widely dispersed shows of gas have been natural gases of flammable character; however, two known localities of gases with appreciable quantities of "exotics" are becoming of increasing importance to the gas industry and potential of northeast Arizona. These are the Boundary Butte anticline, in the Four Corners area, and the Pinta Dome area east of Holbrook on the Mogollon slope.

Gas Analyses

A summary of the critical features of natural gas throughout the basin has significance not only to the marketability of the gases, but also to the theory of origin of these gases. Flammable-gas analyses of the Boundary Butte area, for example, may be summarized by major components as follows:

Flammables

Component	Per cent
Methane	75-86
Ethane	3-5
Helium	traces
B.t.u., units	797-1,118

Exotic gases of the Pinta Dome area may be summarized in a similar manner:

Inerts

Component	Per cent
Helium	1.07-8.29
Nitrogen	19-90
Carbon dioxide	balance

ABOUT THE AUTHOR . . .

Daniel S. Turner received a PhD. in geology from University of Wisconsin in 1946, after 4 years as a U. S. Navy frogman in the Pacific.

His work in Black Mesa basin of Arizona began with uranium-property investigations in 1948, and developed into a major study of the oil and gas potential of the area in 1956. He is president of Dan Turner & Associates, Inc., consulting geologists, Denver.

From the above summary of analyses it is observed that, in gases with high percentages of flammables, the helium traces are very low as a general rule. Among the exotic gases it is significant that no flammable components are present. When the helium content is high, in an exotic gas of this area, the carbon dioxide content drops to a very low figure, with the remainder of the total inert gas being nitrogen in the range of 90% of the total.

A corollary to the above rule suggests that when the helium content is low, in the range of 1%, then the carbon dioxide content rises into the 80-% range with nitrogen forming the small remaining balance. These observations are probably of importance to the interpretation of the source of the inert gases, and may be related to the composition, nature, and proximity of deep-seated igneous intrusion.

Structure and Igneous Intrusives

Complete mapping of the Black Mesa basin has presented abundant proof of myriad folds, both anticlinal and monoclinal, of startling continuity and length. Many closures have been mapped in relationship to the two principal tectonic trends within the basin. The principal trend of folding lies on a northwest-southeast strike and includes the major anticlinal features of the area. A secondary and superimposed trend lies at right angles to the northwesterly pattern and includes the principal monoclines and faults of northeastern Arizona. The northwesterly tectonic trending elements are probably basement controlled, whereas the northeasterly elements are of more superficial compressional origin.

Relating the occurrence of gas to the tectonic origin of structure suggests that exotic gases, or inert gases, are possibly related to basement-controlled structures and thereby may be associated with attendant intrusion. Known occurrences of helium and other inert gases seem to be confined to northwesterly trending fold elements. Flammable gases also occur on these structures.

Northeasterly trending elements, containing gas, so far appear to be devoid of any of the exotic gases. Such a tectonic relationship to the variety of gas suggests that the basic control for the origin of structure has something to do with the character of gas accumulating in any suitable reservoir of any age. Exotic gases have been found in the Cretaceous, Triassic, and Permian formations within the boundaries of the map (Fig. 1). A source of exotic gases unrelated to any systematic boundary is therefore strongly implied. Helium may be expected in any suitable reservoir.

Rattlesnake and Hogback fields of the San Juan basin, New Mexico, are not far distant from the Shiprock intrusive and several other volcanic necks and dikes. The Boundary Butte, Bita Peak, and Biklabito dome occurrences of helium and other exotic gases are nearly adjacent to the Carrizo Mountains and numerous dike intrusives exposed at the surface. Appearance of helium at Pinta dome locates an area on the map not far distant from the diatremes north and west of Holbrook and the igneous plugs and dikes north of Holbrook now exposed by erosion of the Triassic-Chinle formation.

Many other occurrences of helium and other exotic gases throughout the world show a plausible geographic relationship to igneous activity. A "direct cause" relationship can be found between intrusives and the appearance of inert gases. Most of the so-called related intrusives, now exposed at the surface, show considerable evidence of primordial solution gas and pneumatolytic features. Most of the intrusive dikes and plugs of this area are vesicular and partly amygdaloidal in texture, suggesting a significant amount of available gas in the magmatic source.

It should be made abundantly clear that the exposure of igneous material at the present surface is only a matter of erosional chance. Visible evidence of igneous intrusion is not required in explanation of the presence of exotic gases.

Deep-seated intrusives, localized by stress relief in the basement complex, appear to be a logical source for the inert gases of the northwesterly trending structural features of the Black Mesa basin. Physical forms of the anticlines and local closures on major tectonic elements may be partly controlled by intrusion at depth. Subsurface dikes, laccoliths, plugs, and sills might be logically anticipated under, or in the vicinity of, many of the undrilled structures in this area. This premise will only be proven with the drill and is considered a major favorable factor in the search for exotic gases as well as flammable gases throughout the basin.

The presence of intrusives, exposed or not yet uncovered, is looked upon as enhancing the potential for oil and gas, **not** as a detrimental factor as so often concerns management in exploration. Intrusive contacts observed at the surface are commonly indicative of "dry," relatively cold igneous material. Minor contact metamorphic halos, measured in inches, are typical throughout this country. Strategically positioned dikes relative to fold axes may in themselves provide additional structural closure for the accumulation of oil and gas without affecting the quality of the reservoir. Close proximity of intrusives to a stratigraphic or structural trap enhances the potential for accumulation of inert gases by providing a nearby source.

Market Is Available

El Paso Natural Gas Co., has been delivering flammable gas across the Black Mesa basin for many years through the multiple line from the San Juan basin to the Los Angeles market. The recently completed Four Corners crude-oil pipeline, from the Paradox basin of Utah, crosses this area southwesterly to Cameron and on to the Los Angeles refineries. Kerr-McGee Oil Industries, Inc., has recently announced plans to construct a helium-extraction plant at Pinta dome to handle 2.5 M.M.c.f.d. Helium will be shipped from Pinta dome by truck and rail to the commercial markets in California.

The U. S. Bureau of Mines has for many years maintained a helium extraction plant at Shiprock, New Mexico, for processing of gases from the Rattlesnake area. U. S. Highway 66 and the Santa Fe Railroad both pass through the southern one-third of the Black Mesa basin offering easy access and trans-shipment facilities from practically any point within the area.

All of the criteria for a major gas boom appear to be poised for the trigger action of a single exploratory success.

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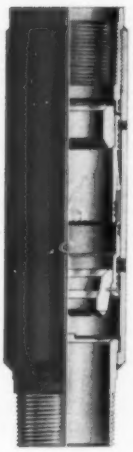
"DV" Multiple Stage Cementer — The depth desired for the upper cement stage determines the point at which the "DV" Multiple Stage Cementer is made up in the casing string. The lower stage of cement is pumped through the end of the string in the usual manner. At this point, an Opening Bomb is dropped to the opening sleeve seat in the "DV" tool. Applied pump pressure against this bomb moves the sleeve down, opening the cementing ports to the well bore through which the upper stage of cement is then pumped. Following cement placement, a Closing Plug is dropped down the casing to seat in the closing sleeve of the tool. Here the novel hydraulic differential principle of the "DV" tool becomes effective. Applied pump pressure moves the closing sleeve down, telescoping it into the opening sleeve, sealing off the ports. The sleeves are permanently locked together and to the lower member of the tool body, preventing them from rotating during drilling out operations. By using displacement type plugs, the upper and lower stages of cement may be pumped together, making the job a continuous operation.



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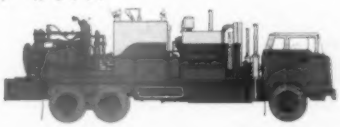

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Gas is major target for explorers in the Green River basin

• Here are described the features that combine to make this basin an attractive province for future exploration. The steady development of the past few years should continue into the future.

BY W. W. SKEETERS

. . . chief geologist for Mountain Fuel Supply Co., Salt Lake City. He is a graduate of Colorado School of Mines, having taken his master of science degree there in 1942. He has wide experience in seismic and geologic work, and has been with Mountain Fuel since 1943, his work centering in Wyoming, Utah, and Colorado.

THE GREEN RIVER basin, by original definition, is bounded by the Overthrust belt on the west, the San Madres Mountains and the Rawlins uplift on the east, the Wind River and Gros Ventre mountains on the north, and the Uinta Mountains and axial basin anticline on the south. This major intermontane basin covering some 21,000 sq. miles in Wyoming, Utah, and Colorado, is subdivided by the Rock Springs uplift and various minor structural divides into the Bridger, Red Desert, Washakie, and Sand Wash basins (see map). Basin nomenclature has become somewhat confused in recent years, but the above divisions will be used here for the purpose of simplicity.

Slow beginning. Although a few shallow holes were drilled in the area around the turn of the century, the systematic search for oil and gas began shortly after World War I. For the next 20 years, exploration continued in a rather desultory fashion, punctuated at intervals by discoveries on more or less prominent surface anticlines. During this period the North Baxter Basin, Middle Baxter Basin, South Baxter Basin, Clay Basin, Hiawatha, Powder Wash, LaBarge, and Big Piney fields were discovered.

The modern phase in Green River basin exploration started with the discovery, by Mountain Fuel Supply Co., of Church Buttes gas field in 1946, the first discovery in southwestern Wyoming credited to the seismic method, and the first Mesozoic production away from the margins of the basin. The ensuing period has been characterized by an intensified use of geophysical methods, a steady refinement in the geological approach, a marked increase in deeper drilling, and an erratic upward trend in exploratory activity.

Green River basin production is presently centered on five major producing areas: the Big Piney platform, Church Buttes field, the Rock Springs uplift—Clay basin, the Vermilion basin, and the Wamsutter arch (see map).

Rock Springs Uplift

The Rock Springs uplift was the site of the first commercial gas production in Green River.

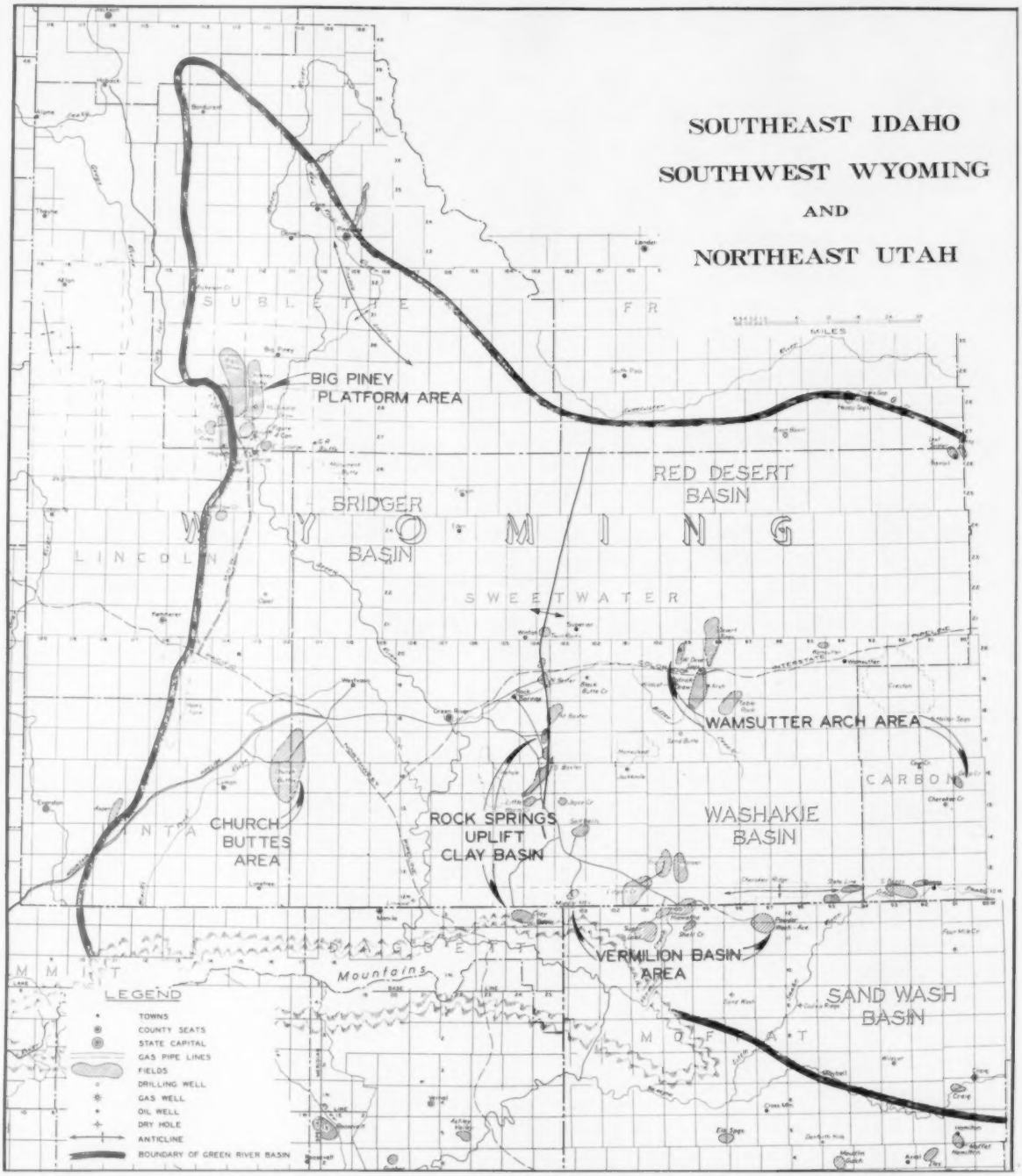
Mountain Fuel Supply Co.'s South, Middle, and North Baxter Basin fields produce natural gas from the Frontier and Dakota Cretaceous formations at average depths of 2,300 and 2,800 ft. respectively. In North Baxter Basin field, natural gas is also produced from the Morrison-Jurassic at about 3,500 ft. and the Nugget-Jurassic at about 4,100 ft.; sulfur-bearing carbon dioxide is present in large volumes in the Weber-Pennsylvanian at a depth of about 6,250 ft. These three formations are water-bearing in Middle and South Baxter Basin fields. The Union Pacific Railroad is the only other major operator in this area.

Mountain Fuel Supply Co.'s Clay Basin field lies about 20 miles south of South Baxter Basin field and is only indirectly related to it, but it is included with the Rock Springs uplift producing area for convenience. Production in this field is from the Dakota at about 5,600 ft., with minor production from the Frontier at about 5,300 ft.

Exploratory drilling on the flanks of the Rock Springs uplift has been largely disappointing. In the area between South Baxter Basin and Clay Basin fields, promising shows have been found in several wells in the Frontier and Dakota formations, and three small fields have been discovered. Salt Wells field, discovered by Husky Oil Co., produces gas from the Dakota and Frontier, and Little Worm Creek and Joyce Creek fields, discovered by Caulkins Oil Co., produce gas from the Dakota. Little Worm Creek also produces some oil from the Morrison and Joyce Creek produces gas from the Frontier. Caulkins Oil Co. can also be credited with a small Morrison gas discovery in the Black Butte Creek unit on the east flank of the uplift. The outlet for this area is Mountain Fuel Supply Co.'s transmission line to the rapidly expanding Salt Lake Valley market area.

Big Piney Platform

The Big Piney platform is a broad structurally high area bordering on



THE VAST GREEN RIVER BASIN is subdivided into many smaller basin components by the tectonic elements shown here. Principal positive areas are the Rock Springs uplift, the Wamsutter arch, the Big Piney platform, and Pinedale anticline. So far, more gas than oil has been discovered in the basin, and opportunities for future discovery are almost unlimited.

and extending underneath the overthrust fault belt. Accumulations of gas and oil are largely controlled by stratigraphic variations in the Almy (Eocene), Mesaverde, Frontier, and Bear River (all Cretaceous) formations, although a few fields are on prominent anticlines.

The Big Piney platform is one of the oldest producing areas in southwestern Wyoming, dating from the discovery of Almy oil on the LaBarge anticline in 1924. The area lay dormant, however, aside from the steady development of LaBarge field by Texaco Inc. and sporadic drilling in the general area, until the discovery of oil in the Nugget formation at Tip Top by General Petroleum Corp. (now Mobil Producing Co.) in 1951. The impetus provided by this discovery, coupled with the building of the Pacific Northwest Pipeline, led to the development of the area at a steadily increasing tempo, paced by Belco Petroleum Co., Belfer Natural Gas

Co., and General Petroleum. Other major operators in the area are Mountain Fuel Supply, The California Co., Pan American Petroleum Corp., Humble Oil & Refining Co., and Phillips Petroleum Corp.

Although there are many field names in the area, a discussion of individual fields would be pointless, as the fields represent, essentially, a complex of overlapping, more or less continuous, gas accumulations in the Knight (Eocene), Almy, Mesaverde, and Frontier formations. Bear River production is limited to Birch Creek field and immediately adjacent areas, and Nugget production is, so far, limited to Tip Top oil field. Mesaverde production is spotty and Frontier production, although the most widespread and important, is erratic. A few small oil pools are scattered through the Almy and Mesaverde producing areas. Drilling depths range from a minimum of less than 1,000 ft. in the Tertiary areas to 10,000 ft. in the Nugget producing area.

The impressive reserves of the Big Piney platform finds a ready market through the transmission line of Pacific Northwest Gas Co. (now El Paso Natural Gas Co.). All of the gas in the area is committed to El Paso, except that controlled by Mountain Fuel which is transported through El Paso's facilities under terms of an exchange agreement.

Church Buttes

Mountain Fuel Supply Co.'s Church Buttes field is a large isolated gas reserve producing from the Dakota at average depths of about 12,500 ft. Union Pacific Railroad is the only other participant.

Gas from this field is all marketed in the Salt Lake Valley via Mountain Fuel's transmission line. The Church Buttes anticline is developed on a regional anticline nose plunging southward from the Big Piney platform to the vicinity of the Uinta Mountains. Drilling along this trend has been generally disappointing.

Wamsutter Arch

The Wamsutter arch is the structural divide between the Washakie and Red Desert basins. The first Mesaverde gas production in the Green River basin was discovered on this arch by Amerada Petroleum Corp., in 1 Deep Creek unit in 1950. The significance of this one-well field discovery was not fully appreciated until discoveries by Stanolind Oil & Gas Co. (now Pan American) at Middle Mountain, Mountain Fuel Supply Co. at Sugar Loaf and Canyon Creek, and Texaco Inc. at Table Rock raised the Mesaverde group to the status of an important primary objective.

Table Rock gas field, located on a prominent closed anticline on the south flank of the Wamsutter arch, is the only primarily structural accumulation and was the first important discovery on the arch. Although gas in commercial quantities was discovered in the Fort Union-Eocene on this anticline by Texaco in 1947, little development work was done until the discovery, also by Texaco, of gas in the Almond formation of the Mesaverde group and a Lewis (Cretaceous) sand in 1954.

An important reserve has subsequently been developed in this field, but the present play on the Wamsutter arch was touched off by the discovery of Almond and Lewis gas in Desert Springs field by El Paso Natural Gas Co. and by the Ohio Oil Co. in Wamsutter field early in 1958. Subsequent drilling has proved a major reserve of stratigraphically trapped gas in Desert Springs and immediately adjacent fields at depths ranging from 3,500 to 6,000 ft.

Developments in Wamsutter field and other prospects east of Table Rock field have been disappointing. In most of this part of the Wamsutter arch, the top of the Mesaverde is found at depths in excess of 8,000 ft. and the Mesaverde sands, although productive of enticing shows, have been tight.

A limited market is available for gas from the Wamsutter arch though the Colorado Interstate Gas Co. transmission line to the Denver area. The development of an adequate market for this gas must, however, await the authorization and completion of Colorado Interstate and El Paso's proposed extension of the Colorado Interstate line to the California market.

In the meantime, active development is assured by the discovery of a major oil field, producing from the Almond formation, at Patrick Draw, south of Desert Springs field, by El Paso and of a smaller, but important, oil field at West Desert Springs by Texas National Oil Co.

Drilling to date in Patrick Draw field has delineated an oil-producing area 8 miles long by 2 miles wide with production ranging from 10 to 3,600 bbl. per day, and averaging about 800 bbl. per day. The field is easily accessible to the Service Pipeline Co. oil pipeline to Salt Lake City. Major operators in the area are El Paso, Union Pacific Railroad, Texaco, Forest Oil Co., Colorado Oil & Gas Co., and Texas National.

Vermilion Basin

The Vermilion basin is a topographic basin on the northwest flank of the Sand Wash structural basin. For convenience, the area is here expanded to include Powder Wash field to the east and Middle Mountain field to the west. The Hiawatha and Powder Wash fields have been important producers of gas and oil from lenticular sands in the Wasatch-Eocene formation, at depths ranging up to 3,500 and 5,500 ft. respectively, since the early 1930's. Fort Union gas production, at depths ranging up to a maximum of 5,000 ft. at Hiawatha and 8,100 ft. at Powder Wash, was discovered in 1951 and 1952 respectively.

The first discovery of Mesaverde gas in the Vermilion basin was at Stanolind's 1 Middle Mountain unit in 1952, but the active development of the Mesaverde potential followed the discovery by Mountain Fuel Supply Co. of Mesaverde gas at Sugar Loaf in 1953, Canyon Creek in 1954, and Trail in 1958. Important reserves have been developed in Mesaverde sands at depths ranging from 5,200 to 7,000 ft. in these three fields. Mountain Fuel operates all fields in the area except Middle Mountain (Pan American) and West Hiawatha (Texaco, Skelly Oil Co., and Monsanto Chemical Co.). Gas from the area is marketed through Mountain Fuel's transmission line to the Salt Lake Valley.

Future Targets

With three major pipeline outlets in existence and additional outlets projected, the outlook for continued steady exploration and development is excellent. Much exploration re-

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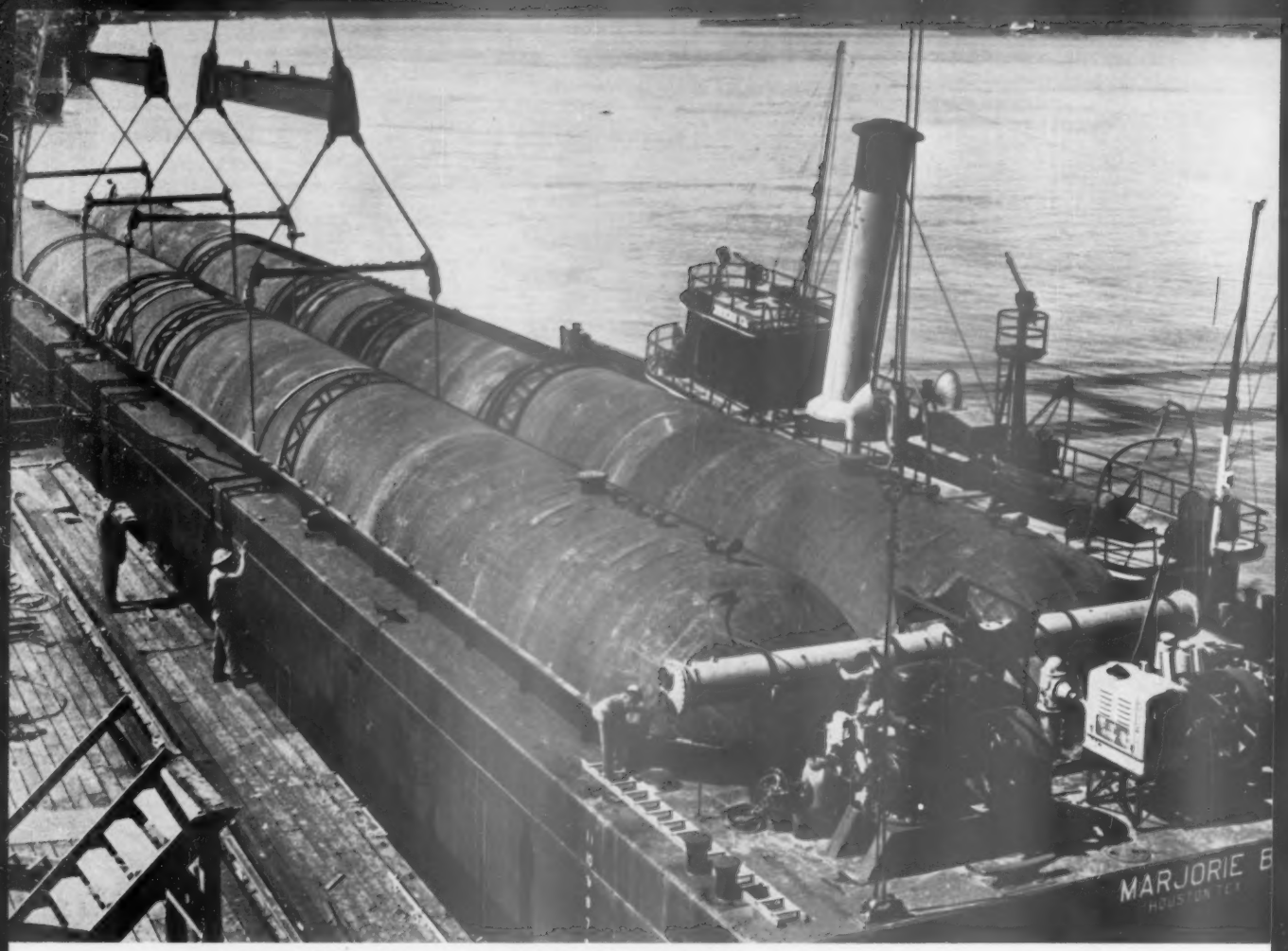

Avondale 600-ton lift lowers 242' O.A. by 16' O.D. tank into position on Phillips Petroleum Company barge. This unit, one of two refrigerated propane-ammonia barges building for Phillips Petroleum, are the largest tank carriers yet to be constructed for the chemical or petrochemical industry for this type service. The heavily insulated tanks will carry 1700 tons of anhydrous ammonia, refrigerated to minus 28 degrees F., by equipment installed on the barge.

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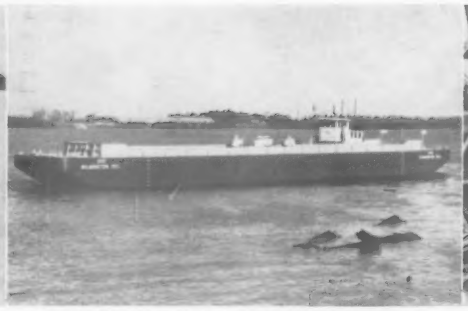
This liquid chlorine carrier was built by Avondale for Monsanto Chemical Co. and measures 195' x 35' x 11'. It contains six tanks, each 8'8" O.D. x 70'0" in length. The capacity of this barge loaded is 900 tons of liquid chlorine.



Liquid chlorine is being transported by this 175' x 26' x 11' cargo barge for the Diamond Alkali Company. Four independent tanks were mounted on saddles and retained by adjustable 3" x ⅛" flatbar straps.

Hull of Phillips Petroleum barge ready for launching at Main Yard. Hopper design accepts two saddle-mounted tanks. The lead barge measures 305' x 44' x 12'6", the trailing barge 284' x 44' x 12'6". The pair are designed to be handled either independently or as an integrated tow.

Spread on these pages you will see a portion of the ever-increasing Avondale-built barge fleet—*carriers with a different mission.* They're big, they're specialized—they're *super* carriers—custom-built for the chemical and petrochemical industries.

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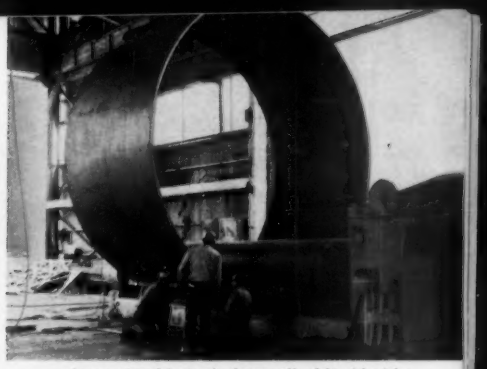

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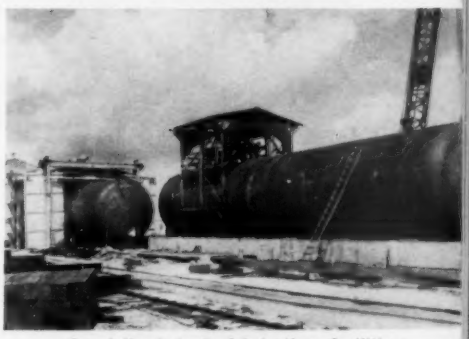

Specialized tank fabricating facilities. Foreground; tank nearing completion on aligning platten, left background; tank being stress relieved in Avondale 18' x 18' unlimited length stress-relieving furnace.

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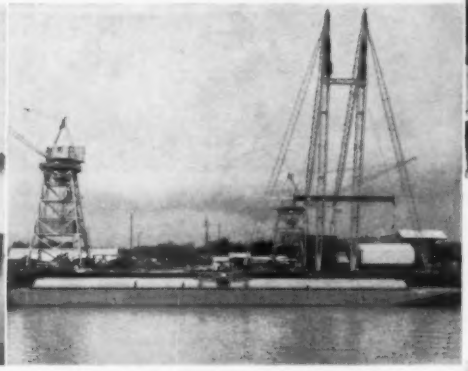
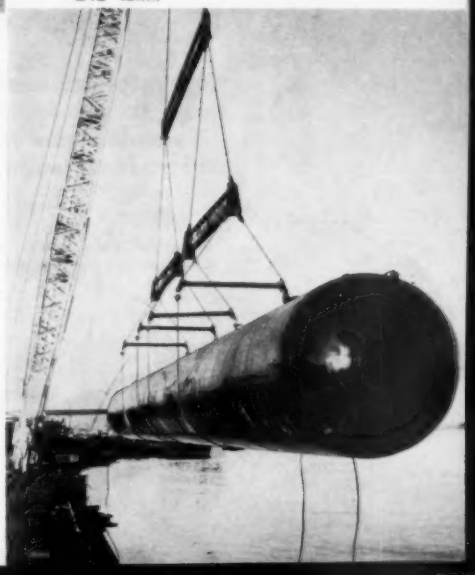


One of two independent pressure tank barges completed for Union Texas Natural Gas Corporation. Each barge measures 273' x 41' x 12'6". Each barge contains four cargo tanks 112' in length, each tank with a capacity of 165,000 gallons, for a total barge capacity of 660,000 gallons.



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mains to be done in and near the established producing areas and the stratigraphic-trap potential of the Cretaceous formations is relatively untested over large areas of the basin.

On the uplift. The potential in the Mesaverde group on the flanks of the Rock Springs uplift was demonstrated in Mountain Fuel Supply Co.'s Jackknife Spring discovery in 1961. This well found commercial gas in the Almond and also added the Blair formation of the Mesaverde group to the list of Green River reservoirs. Although many unsuccessful Mesaverde tests have been drilled on the flanks of the uplift, some have been inadequately tested and none have thoroughly tested the Blair. The Frontier, Dakota, and Morrison formations are also promising objectives on the flanks of the uplift.

In Sand Wash. Many relatively undeveloped areas also show definite promise. The natural-gas potential of the Sand Wash basin is indicated by a ring of scattered Tertiary and Cretaceous discoveries, by Gulf Oil Co., Union Oil Co., Phillips, Pan American, and others, around the periphery of the basin.

Washakie. The eastern rim of the Washakie basin also shows definite promise, as indicated by shallow Mesaverde gas discoveries on small structures at Deep Creek, Cow Creek, and Cherokee Creek on the eastern terminus of the Wamsutter arch, and at Savery and Slater in the area east of Baggs. The Cow Creek discovery is of special interest in that gas, in commercial quantities, was encountered in the Frontier and Nugget formations.

Bridger. Another area of future promise is the Wind River trough, along the northeastern margin of the Bridger basin. Drilling, to date, at El Paso's Pinedale field and at Reasor's Pacific Creek well to the southeast indicates abundant gas in the Fort Union, but both areas are plagued with completion problems related to the tightness of the Fort Union sands.

And in deeper beds. The Green River basin also has an interesting unknown potential in the older, relatively untested formations.

The Weber formation (Pennsylvanian) is an unknown quantity. Several wells in the three Baxter Basin fields have penetrated the Weber with disappointing results. At South and Middle Baxter Basin, the Weber produced water, and in North Baxter Basin it produced carbon dioxide gas. The only Weber test in Clay Basin field produced nitrogen gas. However, the G. H. Vaughn 1 Dad unit tested significant quantities of oil from the Weber in 1950, but an attempted completion failed. The Weber, therefore, must be considered as a possibly productive formation in the Green River basin, but would be at prohibitive depths over most of it.

The older Pennsylvanian rocks and the Madison formation (Mississippian) have not been tested in the Green River basin. Although extreme depth makes them impractical objectives over most of the area, they are within feasible drilling depths on the major anticlines.

The Green River basin presents many relatively untested areas with good stratigraphic-trap possibilities, and many structural traps probably remain to be found and drilled. It is an area of multiple pays, and in many areas several of these pays are available in any one well. Over most of the basin, no special drilling problems are encountered, but many of the remaining prospective areas will require deep wells with attendant high costs. The Cretaceous sands, especially those in the Mesaverde, are subject to varying degrees of water blocking and also require very careful and thorough testing to insure that no producing zones are passed up. Consequently, where practicable, it is advisable to drill the Mesaverde interval with natural gas or air as the circulating medium.

Artificial stimulation is not generally required, but the deliverability of most Cretaceous wells is materially improved by sand-oil treatment.

All of these factors combine to make the Green River Basin an attractive province for future exploration and the steady but active development of the past few years should continue into the foreseeable future.

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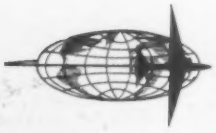

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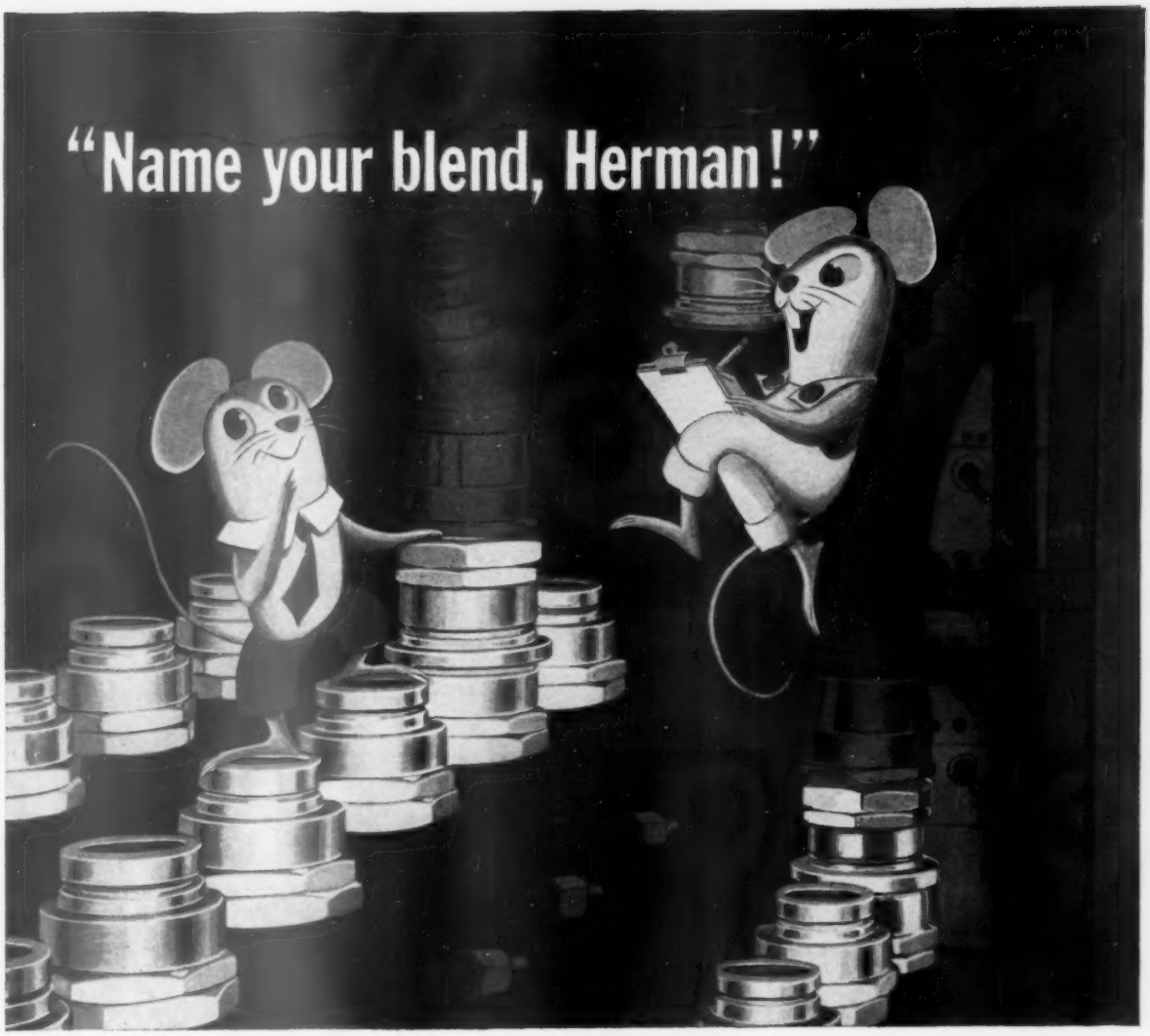

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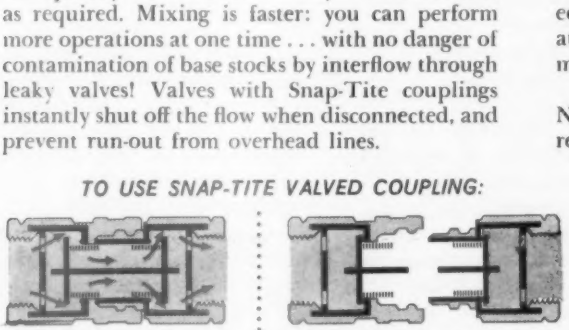

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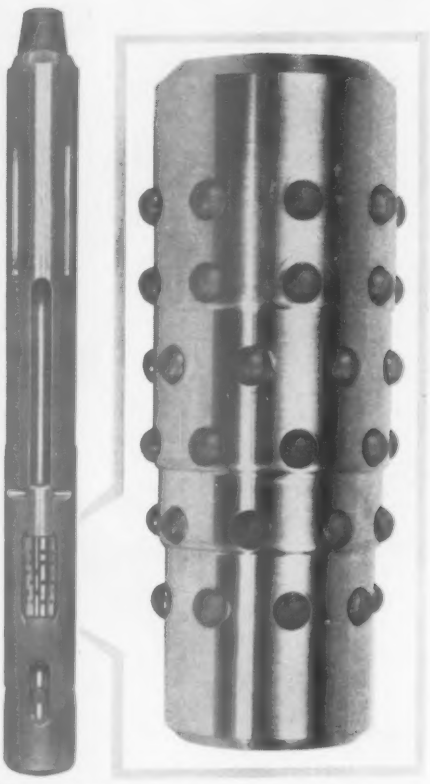
UNION CITY, PA.

REAMER IN GAGE, BIT OUT; that's the finding on this drilling assembly just pulled by Brewster Bartle Drilling Co.'s Rig 16 in Pearl field of Lea County, New Mexico. Here, Driller L. W. Cole (left) and Tool Pusher John Irons find bit is ½ in. undergage; insert-type reamer is still at full gage.



TUNGSTEN-CARBIDE INSERTS on the reamer cutters are like those used in "compact" or "button" type bits. Actually, cutters ream out hole slightly larger than bit gage; this doesn't prevent their being run through gage hole.

Tungsten-carbide inserts slash reamer costs in hard-rock drilling

Insert-type reamers resist abrasion and keep hole in gage longer

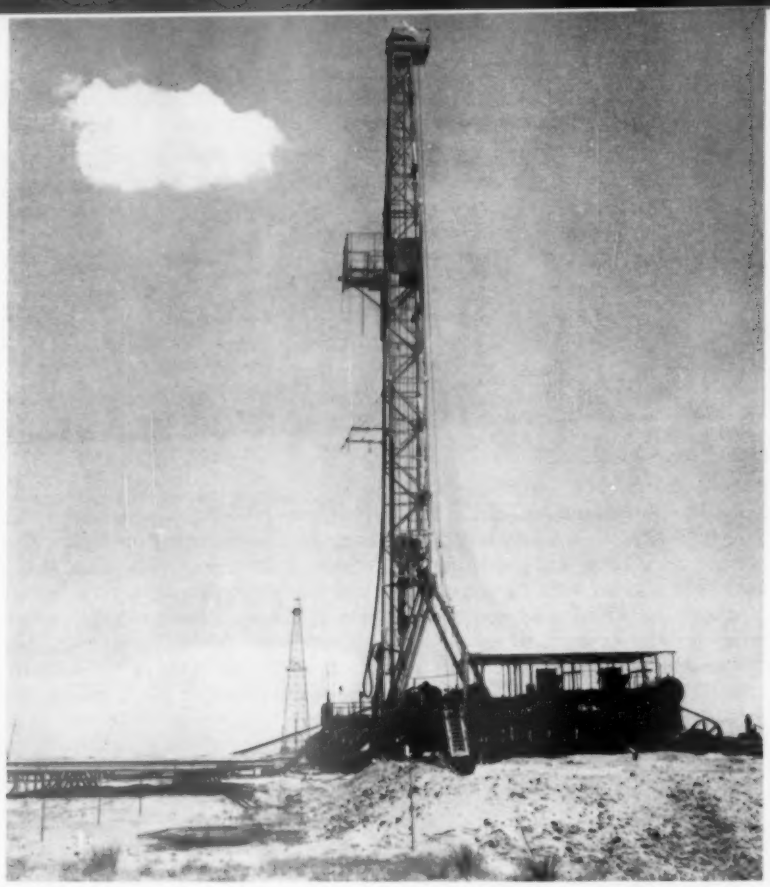
"WE SET UP $1,750 for reamer expense on a well we drilled not long back," says a West Texas drilling contractor. "That was figuring conventional reamers. Instead we spent $450 for one of the new reamers with tungsten-carbide inserts. And, we used it on two wells and part of a third.

"What's more, we didn't ruin one bit by pinching; the hole stayed in gage. Since that time, our reamer bill using the insert type has been about 10% of what it used to be with the conventional type."

BY ED McGHEE
Drilling Editor

The tools this contractor is so enthusiastic about have proved equally successful in other hard-rock-drilling areas. Secret of the reamer is that it uses "inserts" or "compacts" of tungsten carbide; older styles use either milled teeth or virtually smooth rollers surfaced with tungsten carbide. The compacts now being used are almost identical to those used in insert-type drilling bits—often called "chert" bits or "button" bits.

Contractors are quick to state that not all of the reamer saving is a result of using the tungsten-carbide inserts. Improvements in bits themselves have helped; for instance,



IN BAKKE FIELD of Andrews County, Texas, two neighboring rigs drill abrasive formations which formerly required as many as five or six sets of conventional reamer cutters per hole. Now, one set of insert-type reamer cutters drill as many as three 9,400-ft. wells. Bit life is longer too because new bits don't have to ream old, undergage hole.

many-insert-type bits now have compacts on the gage surface of the cones. These gage-protected models have consistently drilled farther without becoming undergage than can older-style bits. Bit manufacturers have made other changes which help resist bit "pinching."

Nevertheless, much of the credit goes to the new reamers. For hard-rock drilling, many say they are as much improvement over older reamers as were the first button bits over the milled-tooth bits of 10 years ago. This isn't to say that the insert-type reamers can be used only with insert-type bits. In fact, some of the most spectacular savings have come in areas where the insert-type reamer was run above milled-tooth hard-formation bits.

Undergage hole a headache. There are many areas throughout the world where hard, abrasive formations gradually wear away the outside cutting structure of the bit. Result is that each foot of hole can be slightly smaller in diameter than the foot before. If gage wear is bad enough, each new bit going into the hole must first ream its way to bottom before it can drill any new hole. This reaming to bottom is costly in two ways. It wastes valuable rig time. And it reduces the footage drilled by each bit. In some areas, it has been common for each new bit to lose as much as 25% of its potential service life as a result of reaming undergage hole.

It's almost always imperative that the hole be brought back to gage diameter in one way or another. Undergage holes "pinch" bits and they will not pass near-gage-diameter tools and pipe. Moreover, the more undergage a hole is, the more danger there is of sticking the drill string.

In areas where formations are not abrasive, milled-tooth reamers do a good job. In mildly abrasive areas there has been good success with reamers which are fitted with smooth rollers surfaced with tungsten carbide. However, in other areas, both these types of tools may lose gage quickly. As a result, drillers have found themselves still reaming some distance to bottom because the reamer cutters had been badly abraded or because cutter bearings had worn. In some wells the reamer expense has been as great as the bit expense.

After insert-type bits proved so successful, it was only natural that their principle be applied to reamer cutters. Now, after several years of design and testing, insert-type reamers are being widely marketed by Drilco Oil Tools, Inc., Midland, Tex. The firm refers to its design as the "Knobby" reamer. Bodies of the reamer are rented or sold and cutters purchased as replacements.

True rolling cutter. Cutters on the insert-type reamer are mounted on an axis parallel to the axis of the reamer body. Result is that the reamer cutters have a true rolling action; they don't tend to scrape or gouge. The inserts remove rock from the hole wall by crushing, flaking, and chipping.

The tungsten-carbide inserts themselves are spaced so that no more than two or three on each cutter will be in contact with the hole wall at any time. Intent of this arrangement is to keep force on cutter bearings low. The combination of true rolling action and low loads results in longer bearing life.

TABLE 1—RECORD OF 24,622 FT. OF HOLE DRILLED BY ONE SET OF 6¾-IN. REAMER CUTTERS IN SEVEN DIFFERENT WELLS

County—	Interval drilled— Depth in	Depth out	Footage drilled	Bits used in same interval
Pecos, Texas	1,550	5,282	3,632	22
Pecos, Texas	1,600	5,360	3,760	22
Crane, Texas	566	3,400	2,834	5
Lea, New Mexico	180	3,769	3,589	14
Lea, New Mexico	1,325	4,450	3,125	14
Lea, New Mexico	339	4,951	4,612	10
Lea, New Mexico	1,350	4,370	3,070	13
Total			24,622	100

TABLE 2—COMPARATIVE REAMER RUNS, FLUVANNA FIELD, BORDEN COUNTY, TEXAS

Well	Oper-ator	Con-tractor	Number sets reamer cutters used	Interval drilled—Depth reamer in	Interval drilled—Depth last reamer out	Number trips with reamer	Type of cutters	No. of trips necessary to ream back to bottom
1	W	H	1	2,366	8,186	27	Insert	None
2	W	D	1	2,373	8,276	25	Insert	None
3	W	G	7	2,212	8,160	20	Conventional	3
4	W	C	4	2,400	8,355	33	Conventional	1
5	W	G	7	2,420	8,250	27	Conventional	None
6	E	R	7	2,370	8,440	27	Conventional	11
7	B	T	1	3,538	7,981	22	Insert	*1

*Note: Reamer was not used above bit run previously.

Actually, the insert reamer enlarges the hole to a diameter greater than bit gage. Reason is that the uppermost row of inserts is set on a diameter greater than nominal bit size. As a result, the reamer continues to produce a gage hole even after there has been severe wear on the inserts.

The overgage feature does not prevent the reamer from running through gage hole, however. When being lowered into the hole, the cutters turn and align themselves so that no buttons are at their extreme distance from center. Thus, with cutters in effect "retracted," the overall reamer is gage size.

It isn't practical to put such an overgage arrangement into milled-tooth reamers; they contain too many teeth spaced too close together. And, certainly, the reamers which use smooth cutters surfaced with tungsten carbide cannot be made to ream out larger than bit diameter.

Field results good. Probably the most spectacular performance turned in by the Knobby reamers was on rigs 2 and 6 of Dual Drilling Co. in West Texas and Southeast New Mexico. Table 1 summarizes the seven wells drilled with one set of reamer cutters. The same set lasted through 24,622 ft. of hole and 100 6¾-in. bits. During the entire period there was practically no reaming to bottom with new bits.

It isn't always possible to use the same set of cutters on two wells in the deep-drilling areas. But, as one contractor said, "It's surprising how many times the cutters do go in a second hole."

Sometimes in Midland Farms field of Andrews County, Texas, a second set of reamer cutters is required to bottom out one of the 12,400-ft. wells. If so, however, the second set is often still good enough for use in another well. Contrast this performance with 2 or 3 years back when it was common to use 14 or 16 sets of conventional reamers in this same field.

Just north of Midland Farms at Bakke field, contractors have drilled as many as three wells to 9,400 ft. with one set of insert-type reamer cutters. Ordinarily, however, one set of 8¾-in. cutters is used on each of these wells. Deeper wells (12,300 ft.) in the field now generally manage on a single set of insert-type cutters. In the past, 5 or 6 sets of conventional cutters had been used to the 9,400-ft. pay and as many as 10 or 12 sets of 6-point reamer cutters to the 12,300-ft. zone.

Contractors drilling in Breedlove field of Dawson County, Texas, expect to use two sets of the insert-type reamers to reach 12,400 ft. Usually the second set can be rerun. The highly abrasive formations in this field have made it necessary to run as many as 14 to 17 sets of conventional cutters to the same depth.

Three years ago in Loco Hills field of Eddy County, New Mexico, it was common to use as many as 35 to 40 sets of conventional reamer cutters to reach 7,500 ft. There are on record wells which used as many as 105 sets. Now, wells in the field are drilled with only two sets of insert-type reamer cutters. It is typical that the second set of these cutters will be pulled at total depth still in full gage. The two sets of Knobby reamers are run and rerun while some 38 bits are drilled.

Another impressive performance has been scored by the insert-type reamers in Fluvanna field of Borden County, Texas. As Table 2 shows, there were six different drilling contractors on seven wells for three separate oil-company operators. The three wells using insert-type reamers bought only one set of cutters each. There was no instance where it was necessary to ream to bottom with a new bit. One of the wells required reaming of 50 ft. but in this instance the reamer had not been used on the previous run.

On the other hand, the hole had to be reamed down with new bits on at least 14 trips when conventional chert-type reamers were used. On one of the wells, four sets of cutters were used; another required seven sets of a like brand. Seven sets of a second brand were used on one well and seven more sets of the same brand were used on another.

NEXT WEEK

Special Coverage of API Pipeline Meeting

OUTSTANDING papers from the API pipeline conference in St. Louis will be the highlight of the Journal's May 1 issue.

This special report will include significant papers on:

1. New developments in pipeline operations.
2. Comparison of LPG storage in mined caverns and salt strata.
3. Operating pipelines with fewer but more qualified employes.

Watch for the Journal's special API pipeline report in next week's issue.

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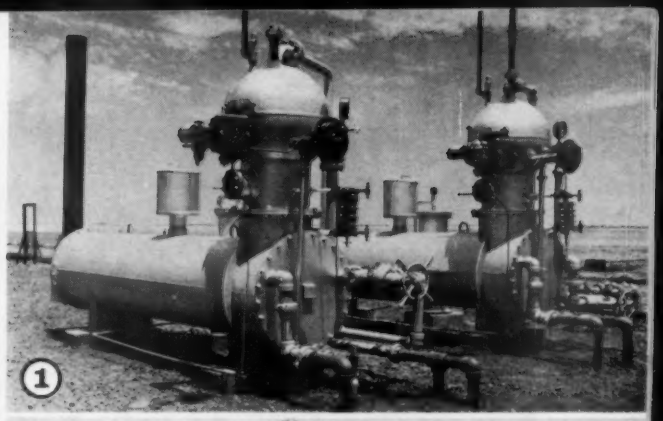

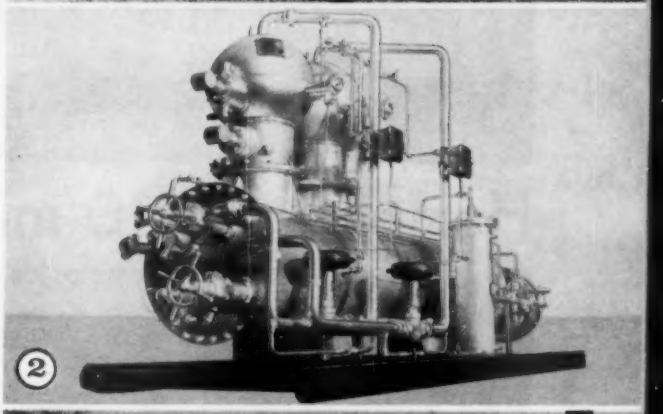

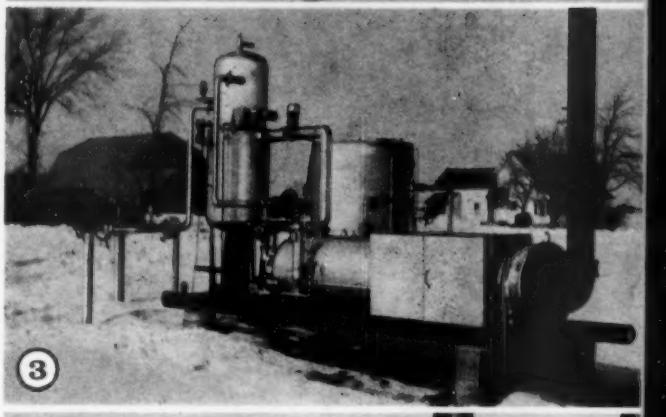

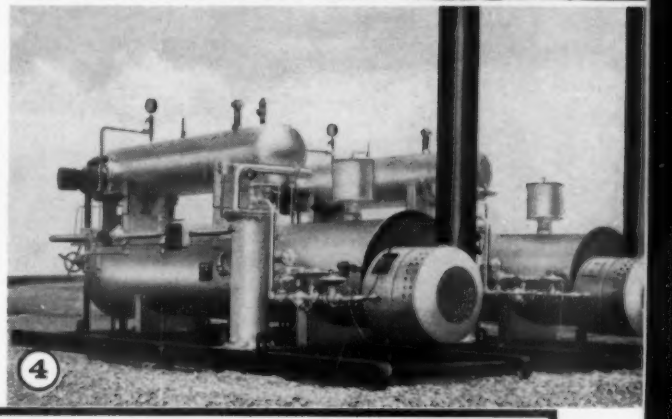

There is a BS&B FREE-O-FREEZ unit designed to solve your cold weather production problems:

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2. *The "Double Dip" is identical to the spherical FREE-O-FREEZ except that it processes two well streams in the same unit at the same time.*

3. *This versatile unit designed to handle gas streams containing viscous fluids that tend to foul the operation of conventional equipment. This is another example of how BS&B engineering and know-how solves difficult production problems.*

4. *The horizontal FREE-O-FREEZ is recommended for leases where there are surge problems. Inlet gas heat is utilized to keep liquid from freezing in the separator. This is accomplished by piping the inlet gas through a coil in the liquid section of the separator.*

FREE-O-FREEZ units are Compact, Skid-mounted, and provide Dependable, Automatic, Trouble-free operation in all types of weather. FREE-O-FREEZ units are equipped with a safety first—the BS&B flash arrestor which eliminates flash backs and provides maximum burner safety.

A call to your local BS&B representative is all that's needed to end your cold weather lease production problems: Or write: BS&B, Dept. 1-A4B, 7500 East 12th Street, Kansas City, Missouri.

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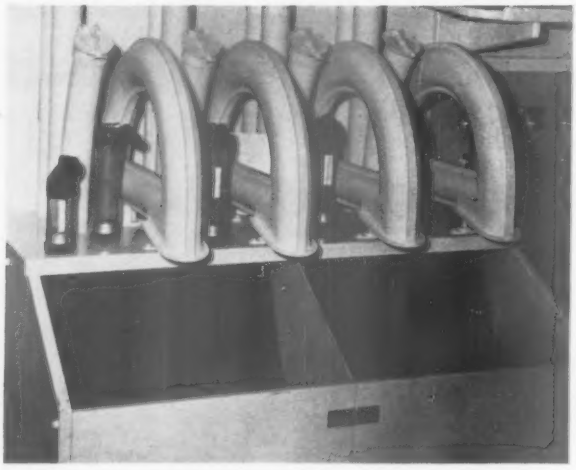
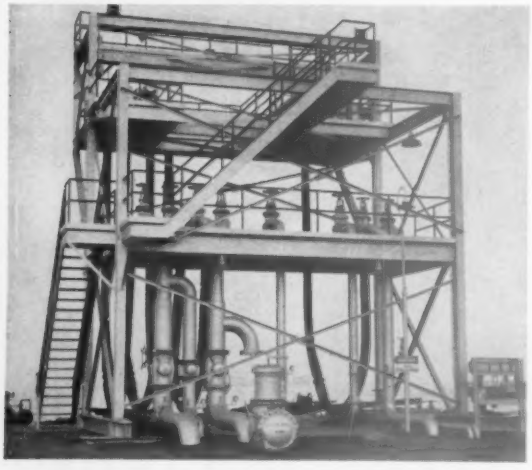
Hartol's new 10-minute loading terminal

uses closed-circuit TV . . .



pneumatic tubes . . .



gantry crane, and . . .

remote gaging

How it's done is told on the facing page→

MORE EFFICIENT operation is the goal of every part of the oil industry and marketing is no exception. A good example of what's going on in marketing is the bulk terminal which Hartol Petroleum Corp. has remodeled at Baltimore.

This terminal can receive, load, and dispatch a truck in 10 minutes. It has loaded as many as 125 trucks with 600,000 gal. of product in a single day and can do much better.

In order to perform this feat, the Baltimore terminal uses a variety of audio, visual, and mechanical devices. Operating as a unit, they enable the dispatcher to load at the rate of 650 g.p.m.

The Hartol terminal is believed to have the fastest loading facilities on the eastern seaboard. It's a speed that the customers like. Some have found that a truck using this terminal can average an extra round trip per day. On a percentage basis, this is a huge increase.

These are some of the features of the Baltimore terminal:

- **Closed-circuit television** which enables the dispatcher to position trucks in the four-bay, eight-position loading rack.
- **Intercom and loud-speaker** communications by which the dispatcher and the drivers can communicate when the latter are in their trucks or on the platform.
- **Pneumatic tubes** which convey tickets from the dispatcher to driver and back in a matter of seconds.
- **Remote gaging** and temperature recording which enable the dispatcher to check the contents of any tank at any time.
- **Oversize pipelines,** 16 in. in diameter, which make high transfer rates from dock to storage possible.
- **Large-diameter hoses** for unloading tankers. These hoses are controlled from an elevated platform on a finger pier that can accommodate large product-carrying tankers.

When a truck enters the terminal yard, it trips a buzzer in the dispatcher's office. A sign directs the driver to stop at a two-way speaker system. There he identifies himself, gives truck number and company and the type and quantity of product he wants to load. The dispatcher then tells him which lettered position he is to take.

While the truck is in loading position it is constantly in view of the dispatcher through closed-circuit television. A camera is mounted over each position and transmits a picture of the loading operation to receivers on the wall of the dispatcher's office, 200 ft. away.

Tube handles ticket. The dispatcher writes up the ticket and sends it through the pneumatic tube to the position to which the driver has been assigned. The driver signs it and returns it by the same route. While the ticket is on its way back to be inserted into the meter in the dispatcher's office, the driver pushes the metal catwalk down on his truck, moves the spout to the loading position and connects a ground clamp.

The fuel pump will not operate until the ground clamp is attached. When this safety precaution is taken, a light comes on in the office and product starts flowing into the tank.

Dual meters are installed in the office and on the platform. The driver watches the latter and shuts it off when the truck has taken on its load. The dispatcher removes the ticket from his meter, signs it, and sends it via the tube to the driver. The driver, meanwhile, has returned everything to its position at the rack and, as soon as he gets the ticket, takes off.

Rail siding available. Most of the product coming in to the terminal arrives by tanker and most leaves by truck. There is a rail siding which permits the terminal to receive or ship by rail.

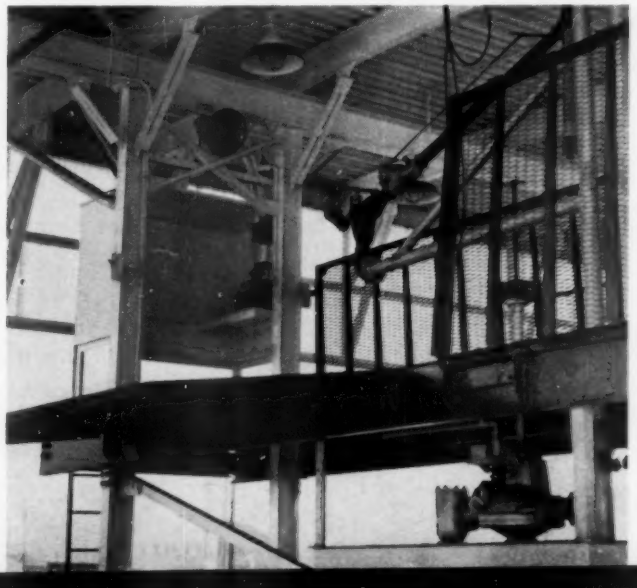
The finger pier in the Baltimore harbor is about a mile from the terminal. The pier is equipped with a gantry crane to speed the connection of the large-diameter hoses to the tankers. Four 16-in. pipelines deliver products to the terminal's 1,100,000 bbl. of tankage. Rubber spheroids are used to separate batches.

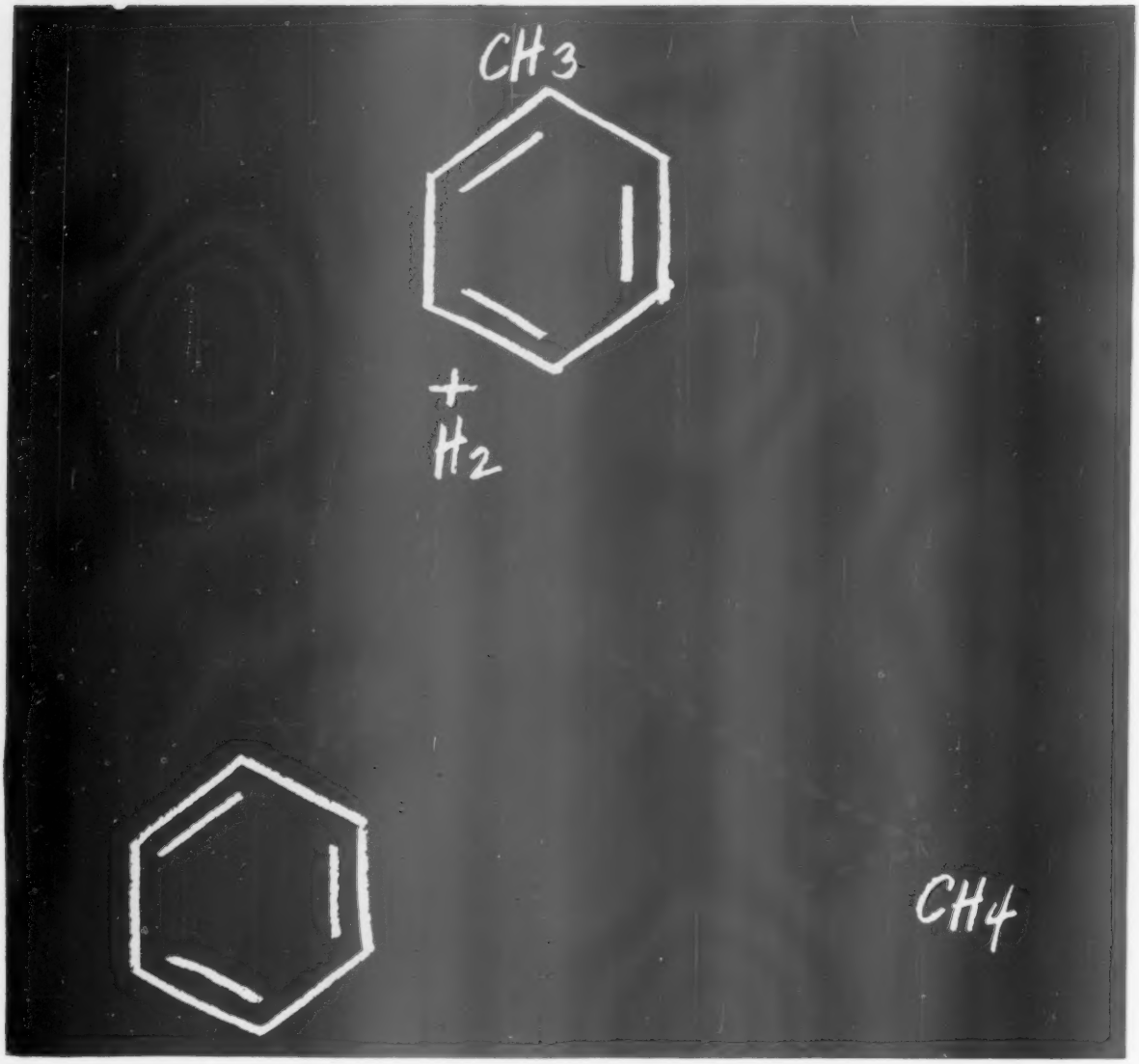
The remote tank-gaging system uses both liquid-level gages and midpoint thermometers that register continuously on a panel in the dispatcher's office. In addition there are audible and visual signals to indicate when tank filling reaches a predetermined level.

While the terminal has loaded 125 trucks with 600,000 gal. of product in a single day, it has the capacity to handle considerably greater quantities. It will be duplicated to a large degree when Hartol, a subsidiary of Tennessee Gas Transmission Co., completes another terminal which is now under construction at Norfolk, Va.

LETTERED POSITIONS are assigned to each truck driver by two-way speaker system.

DUAL METERS on platform and in dispatcher's office give simultaneous readings at both points.





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- DETOL offers fullest development of advantages inherent in dealkylation of alkyl aromatics by use of a catalyst . . . high conversions per pass, accompanied by high selectivity, minimum loss to undesirable by-products. Benzene yield in reactor effluent is 96.5 mol percent or better of fresh toluene charge.
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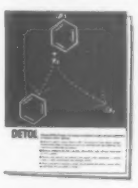

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BY W. L. NELSON, Technical Editor and Petroleum Consultant

Bring us up to date on cost of water-cooling towers

Can you please bring us up to date on the cost of cooling towers? Your costimating article of January 7, 1957, shows indexes to 1956 only. S.Wm.T.

More dependable data for the computation of a cooling tower index are now available. Accordingly, Table 1 on this page shows revised indices for Redwood and Cypress lumber, and for Cooling Towers.

Technological improvements in the design of forced or induced-draft towers were rapid between 1925 and 1950. This resulted in cost indexes according to H. E. Degler, "Cooling Towers and Air-Cooled Exchangers", (OGJ, Sept. 6, 1951, p. 76) which ranged about as follows:

	5,000 g.p.m.	20,000 g.p.m.
1925	198	210
1932	180	191
1941	171	180
1943-45	88	88
1946	100	100
1950	153	146.5

However, with respect to atmospheric towers, technological advances have not been rapid since 1946, and hence the index shown in Table 1 is based simply on 50% lumber cost (half redwood and half cypress) and 25% each for the two wage items. Induced or forced-draft towers use fans and drives and these constitute about 10-13% of the complete installation cost. Piping to and from the tower is not usually considered as a part of the cooling-tower cost (it is not included in the index) but the pump and the lines (no cooling surface) cost approximately $1.00 - 1.60 (1946) per g.p.m.

The index shown in Table 1 replaces the index published in Costimating No. 24, January 7, 1957, and the lumber indexes also replace those shown in the Costimating series. It indicates slightly higher present prices for cooling towers than the older index, and the difference is caused primarily by the use of revised somewhat higher lumber costs.

TABLE 1—REVISION OF COOLING-TOWER INDEXES (1946 = 100)

	Redwood,* all heart, Clear Code 528-3	Cypress,* finish, C Grade 529-2	Carpenter wages†	Common or helper wages‡	Cooling tower Index§
1946	100	100	100	100	100
1947	140	155	112	115	130
1948	166	178	127	131	150
1949	181	213	130.5	140.4	166
1950	212	250	137	148.1	187
1951	224.5	255.5	146	156.8	196
1952	249	255.5	155	168.2	207
1953	235.5	256.5	162.5	181.2	208
1954	238	253	168	192.1	213
1955	246	255	174	199.4	218
1956	253.5	261.5	181	209.1	226.5
1957	243	265.5	191	221.0	230
1958	204	266.5	200	235.7	226
1959	218.5	267.5	210	248.6	236
1960	212.2	267.6	218	267.7	241.5

*Revised 1946 costs—redwood $93.835 per M.b.f. and cypress $99.072. †Bureau of Labor Statistics, as published yearly in Eng. News Record. ‡Common from Eng. News Record. §Weighted equally for redwood, cypress, common labor, and carpenter labor.

More, please, on underground storage

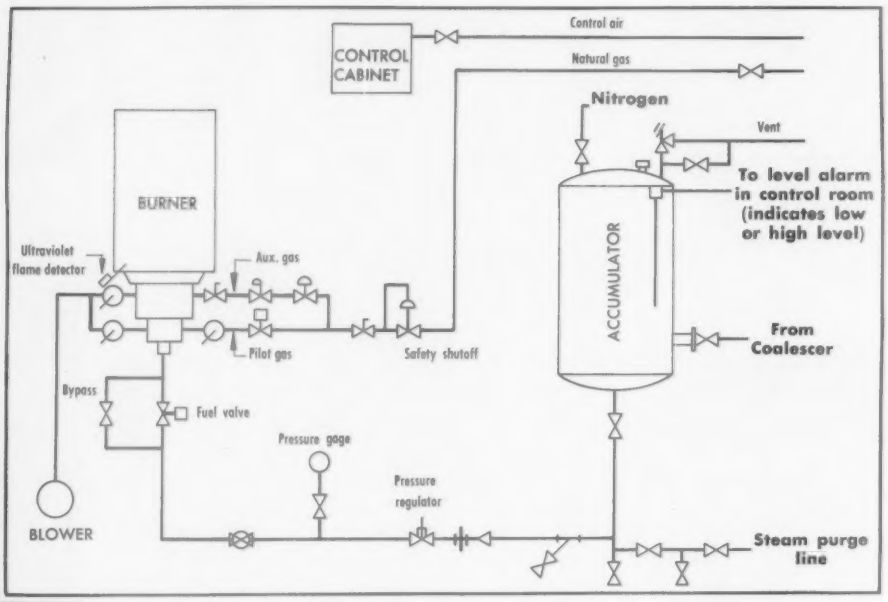
We were very interested in your bibliography of April 18, 1960, on underground storage but we felt that the wrong impression was given when it was stated that "not much detail is available."

Enclosed with the comment was a copy of the excellent "Underground Storage of Liquid Petroleum Hydrocarbons in the United States," compiled by the Research and Coordinating Committee of the Interstate Oil Compact Commission (1956). This 104-page booklet, in fine print and with numerous maps and sketches, consists primarily of discussions of the geology of 42 states as related to the possibility of storing liquid petroleum (100 pages). The storage of ethylene (the main question of the April 18 issue of Questions on Technology) may be mentioned in the booklet but it is not listed on the contents pages. Although the booklet contains at least 164 references, all but about 13 of them pertain to geology. The Interstate Oil Compact Commission report is a valuable contribution to the literature especially with respect to suitable locations for underground storage.

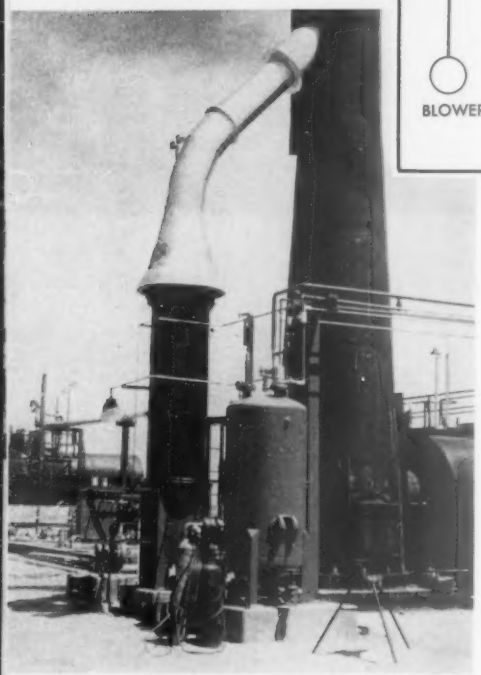
How viscosity affects performance of centrifugal pumps

We hear that you have published data or curves on centrifugal-pump performance in viscous liquids. Can you direct me to this? We obtain performance curves for a 30°-API crude oil of 50 S.s.U. at 100° F. viscosity and we want to correct these to the performance on water. E.L.D.

What I have published is probably already well known to companies that manufacture pumps. Pages 129 and 130 of the October 25, 1947, issue of The Oil and Gas Journal contains my Refiners Notebook No. 167 entitled, "Viscosity and Centrifugal Pumps." It suggests factors (percentages) by which the performance curves of a centrifugal pump, when operating on a 50-S.s.U. material at pumping temperature, can be converted to new values for materials of other viscosities.



ALUMINUM CHLORIDE complex is burned in this unit at American Oil Co.'s Yorktown, Va., refinery. Schematic diagram of incinerator unit shows the basic equipment. Any material with a boiling point within 500° to 4,200° F. can be burned.



Incineration solves a waste-disposal problem

DISPOSAL OF WASTES by incineration is growing in favor among all segments of industrial operation.

One such system is built around a low-cost upfired-retort burner unit made of refractory-lined heavy-gage steel. It's disposing of aluminum chloride complex formed during polybutene production at American Oil Co.'s Yorktown, Va., refinery. Incineration temperature of 3,000° F. insures total burnoff with no visible ash residue and no air pollution.

This same equipment is reported applicable to a variety of other petroleum and chemical wastes, including every known halogen complex.

If the material's boiling point is within the range of 500° to 4,200° F., it can be burned in this upfired retort. Even though a metal oxide is formed following dissociation of the compound, it is so fine that it is invisible when carried out through the stack.

If the waste has a B.t.u. value, it can be used as a fuel. Whether its use as a fuel is partial or total will depend on its ability to sustain the required incineration temperature.

Where the waste has low B.t.u. value or none at all, heat can be supplied from an auxiliary source such as natural gas or fuel oil.

Process flow. The incineration system consists basically of the burner unit with its refractory-lined retort, a blower to provide combustion air, storage tanks for the waste material, suitable piping and valves, and an operator's control panel. Once the unit has been lighted and the pump started, the process is continuous and automatic.

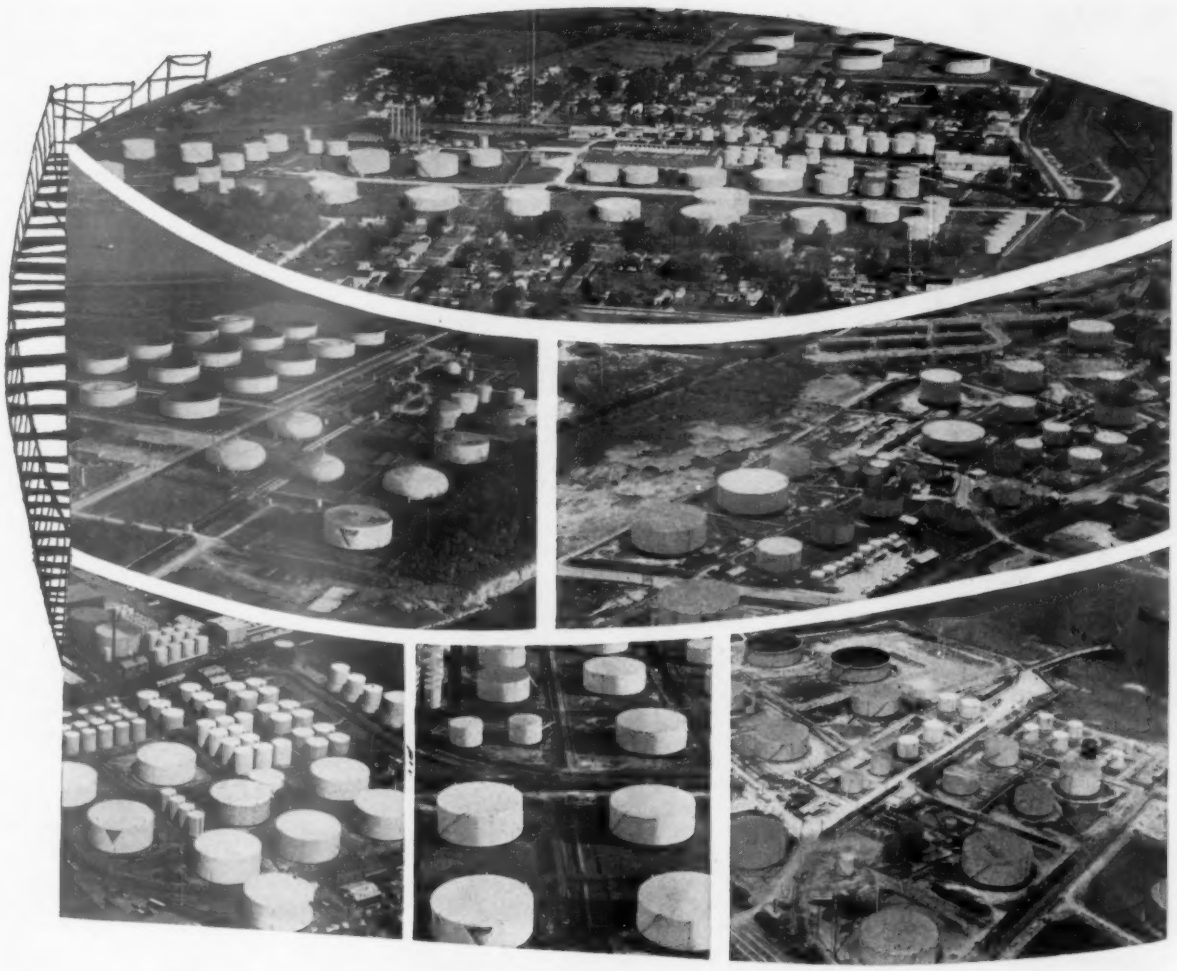
At American Oil's unit, $AlCl_3$ complex settles to the bottom of a coalescer which is maintained at 125 to 175 psi. From here the waste flows to the accumulator which is blanketed by nitrogen (75 psi.), and then to the incinerator where it is atomized through the burner nozzle and burned.

B.t.u. value of the $AlCl_3$ complex is not sufficient to sustain the 3,000° F. temperature required, so the auxiliary heat is provided by natural gas which is fed continuously to the burner. The blower provides combustion air.

The ultraviolet flame detector, safety shutoff valve, level indicator, and pressure regulator are some of the safety devices incorporated in the equipment.

A venturi which is mounted atop the retort stack aspirates air from the atmosphere to dilute and cool the exhaust gases to 250° F.

The unit was designed and built by Prenco Manufacturing Co., Royal Oak, Mich.



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PART 4—HEAT TRANSFER

Control heat input for efficient operation

TO control heat input in furnace operation, one thing to watch out for is tube coking. It is caused by too high heat input or localized overheating. Although modern combustion controls and methods have helped, it's still a big problem.

Controlled heat input eliminates localized overheating. This merely means putting the right amount of heat in the right place at the right time.

A simple example of controlled heat is the baking of a cake. If the oven is too hot, the cake will burn on the outside before the inside is done. Control of heat input to the cake in the oven does not present too much of a problem because the cake does not move about; therefore the heat input can be held constant.

Control of heat input to oil flowing through a furnace is more of a problem and requires close attention.

In a furnace, oil picks up heat as it flows from tube to tube. The rate at which it picks up this heat depends on the furnace design. Some parts of a furnace are hotter than other parts. For a given heat capacity, the heat input to each tube in a furnace is different for a furnace equipped with two burners, compared to a furnace equipped with 20 or 30 burners. The two-burner installation would give more localized overheating, since the heat release at the two burners would have to be very high.

This material taken from process-training-program manual, Bayway, N. J., refinery of Humble Oil & Refining Co.

Heat-transfer rate. When a liquid or a gas is in contact with a solid, a film is formed between the liquid or gas and the solid. Many liquids and most gases are poor conductors of heat, and will cause large temperature drops. In other words, the gas or liquid film is acting as an insulating material.

In a fired furnace, there is a gas film on the outside of the tube and an oil film on the inside. Since a large temperature drop is taken across the two films, this means that the furnace will have to be fired harder in order to get the oil flowing inside the tube up to the required temperature.

Fig. 9 shows how heat from the gas is transmitted through the wall of the tube into the oil.

Suppose in a furnace a thin layer of coke is formed inside the tube. Since coke is an excellent insulating material, the difference between T_1 and T_5 in Fig. 9 would increase considerably. This means that the furnace would have to be fired harder and the temperature at T_1 raised to offset the drop across the layer of coke. This added furnace firing explains why tube-metal temperatures go up when furnace tubes begin to coke.

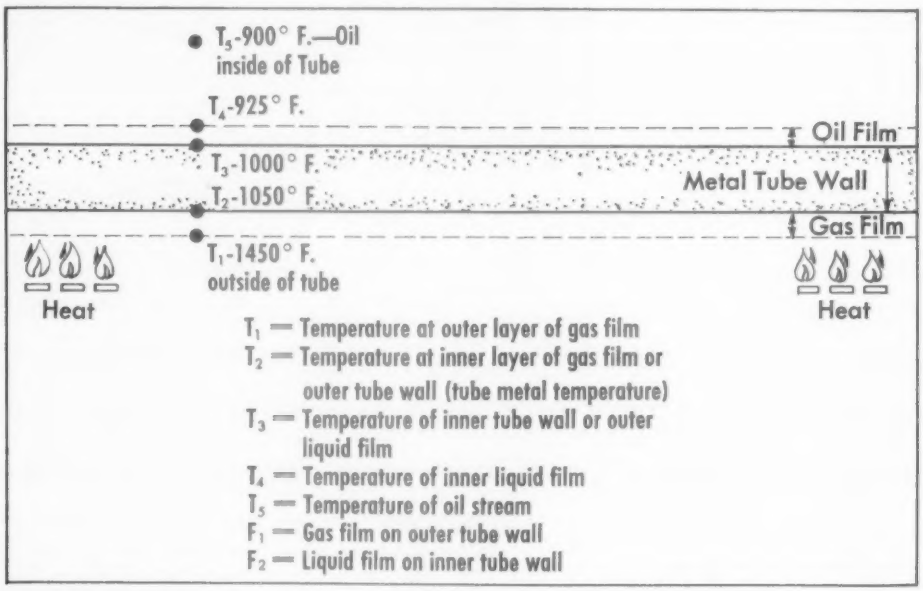
Shell and Tube Equipment

There are three common names given shell and tube equipment depending on the job they do. They are:

1. Heat exchangers. As the name suggests, heat is exchanged between two process streams (usually oil). In the heat exchanger, heat picked up by the cool stream is "free" heat, since the hot stream had to be cooled off anyway. Since conservation of heat results in large fuel savings, heat-exchange equipment is found in most refinery units.

2. Coolers. In many cases it is necessary to cool a process stream, but there is not another suitable oil stream to exchange heat with it. This happens because heat always flows downhill from a material of higher temperature to a material of lower temperature, and frequently there is no oil stream which is sufficiently cooler than the hot stream. In this case, the hot stream is cooled by water in a cooler.

3. Heaters. In cases where there is no suitable hot-oil stream available to heat the cooler stream, the cooler stream can be heated in shell and tube equipment called heaters.


T_5-900° F.—Oil inside of Tube
T_4-925° F.
Oil Film
T_3-1000° F.
Metal Tube Wall
T_2-1050° F.
Gas Film
T_1-1450° F. outside of tube
Heat
Heat
T_1 — Temperature at outer layer of gas film
T_2 — Temperature at inner layer of gas film or outer tube wall (tube metal temperature)
T_3 — Temperature of inner tube wall or outer liquid film
T_4 — Temperature of inner liquid film
T_5 — Temperature of oil stream
F_1 — Gas film on outer tube wall
F_2 — Liquid film on inner tube wall

HEAT FROM BURNERS is transferred through the gas film, the metal tube wall and an oil film before reaching the main body of oil flowing inside the tube. Fig. 9.

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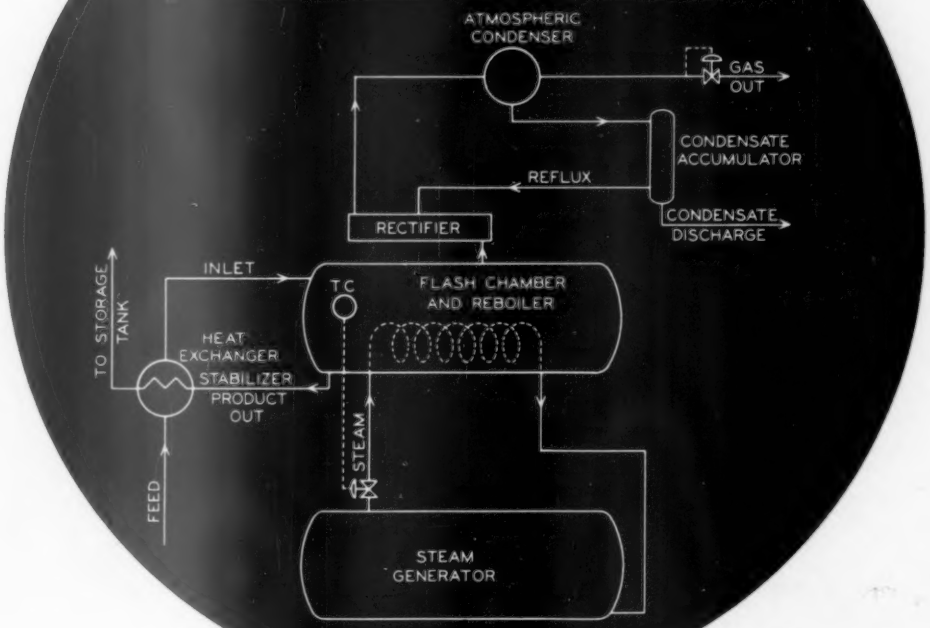

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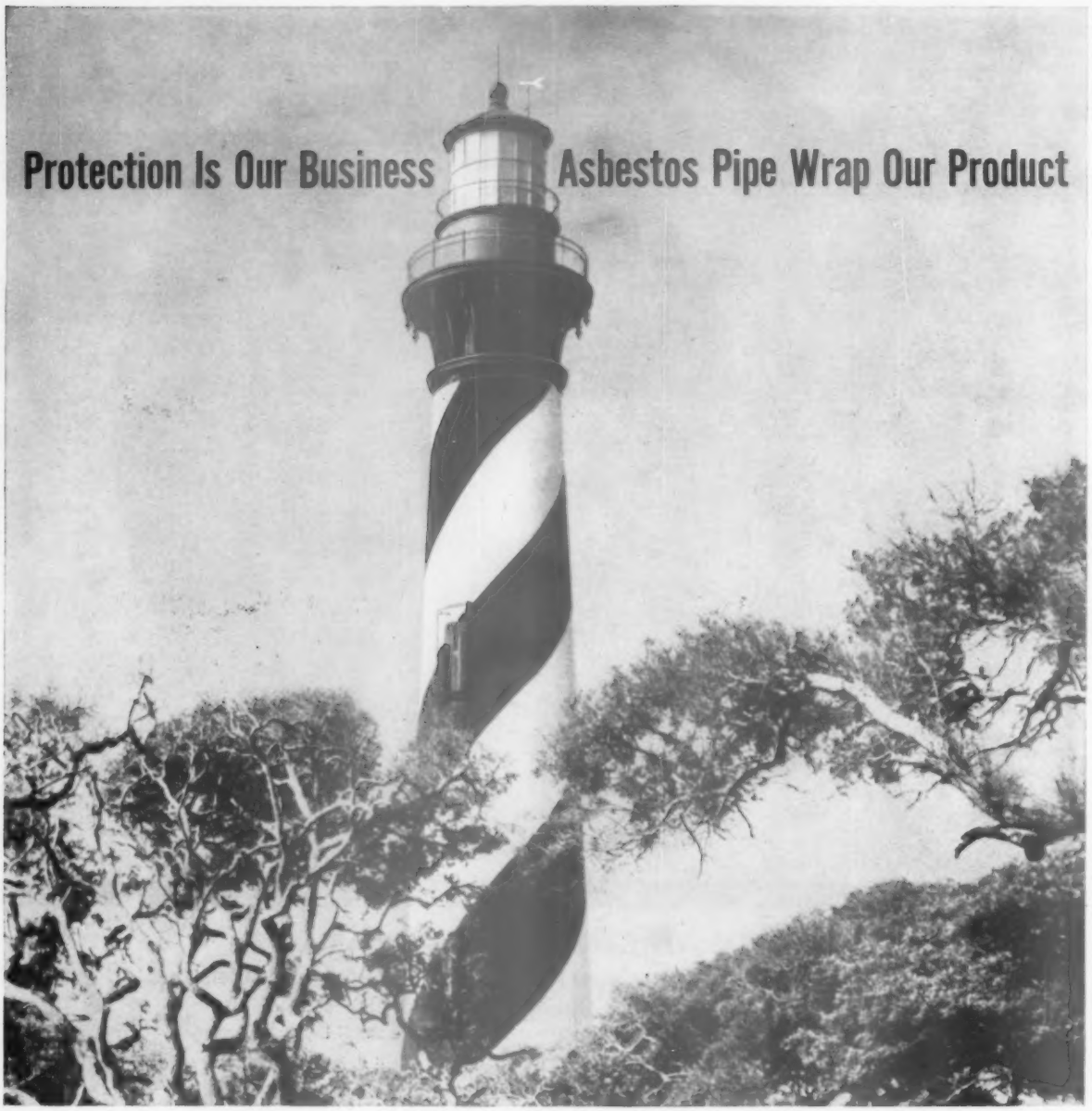

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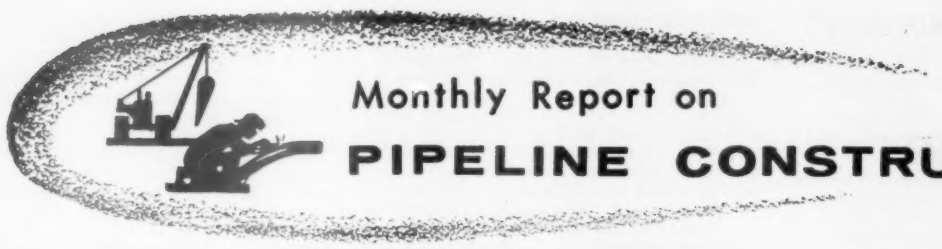

Monthly Report on PIPELINE CONSTRUCTION

PIPELINE ACTIVITY reported here is compiled from surveys by The Oil and Gas Journal among pipeline companies and construction contractors.

This summary report appears in the last issue of the Journal each month. New construction projects are reported weekly in Pipeline Briefs in the Journal's new section.

Projects are listed in three groups—U. S., Canadian, and Foreign—and according to type of line—crude, products, natural gas, or miscellaneous.

★ The star symbol indicates the first appearance of the project in the Journal's survey.

U. S. Crude Oil Pipelines

BELL OIL & GAS CORP., Tulsa.
Project: 12-mile, 8-in. crude oil line from Hewitt to Ardmore, Okla.
Completion: July 1, 1961.

CONTINENTAL PIPE LINE CO., Drawer 1267, Ponca City, Okla.
Project: 4 miles of 3-in., 18 of 4-in., 68 of 6-in., 323 of 8-in., and 53 of 10-in., in new Glacier Pipe Line System from Cutbank, Mont., to Byron, Wyo.
Status: Under way.
Contractor: R. H. Fulton & Co., Lubbock, Tex.
Completion: July 5, 1961.
Project: 20.7 mile, 8-in. crude line from Grand Isle to Golden Meadow, La.
Completion: December 31, 1961.
Contractor: Glaser Construction Co.
Project: Gathering system in Prairie Creek field of Campbell and Crook counties and Bertha field, Campbell County, Wyoming, and 18 mile, 4-in. transmission line to connect with Belle Fourche system at Miller Creek.
Status: Application before Wyoming PSC.

GILLETTE PIPELINE, INC., and **A. W. HARTWIG, INC.**
Project: A 102-mile line from Dead Horse Creek field to Casper, Wyo.
Status: Pending Wyoming Public Service Commission approval.

GREAT NORTHERN PIPE LINE CO., 175 East 4th St., St. Paul 1, Minn.
Project: 64-mile extension of system northwestward to the Lignite field, Burke County, North Dakota.
Status: Planned for 1961.

LAFITTE OIL TRADERS, INC., Bartlesville, Okla.
Project: 9-mile, 4-in. Grand Coulee gathering system, Acadia Parish, Louisiana.
Completion: June 1961.

MATADOR PIPE LINE CORP., Denver, Colo.
Project: 175-mile line from Burke, Bottineau, and Renville counties, North Dakota, to Cromer, Man.
Status: Pending approval of Canadian National Energy Board.

MESA PIPELINE CO., Midland, Tex.
Project: Extension of gathering system to other fields in West Texas and southeastern New Mexico.
Status: Planned.

MID-AMERICA PIPELINE CO., Skelly Building, Tulsa.
Project: 405-mile, 10-in. condensate line from Superior, Wis., to Chicago. It would connect at Superior with the trunk line of Lakehead Pipe Line Co., eastern division of Interprovincial Pipe Line Co. Shipments would be fed into Interprovincial from gathering lines now under consideration in Alberta.
Staus: Proposed.

MID-CONTINENT PIPE LINE CO., Tulsa.
Project: 9-mile, 6-in. crude oil line from Crider field to Maysville station, Okla.
Status: Planned.

NORTHWESTERN REFINING CO., Box 248, St. Paul Park, Minn.
Project: 4, 6, and 8-in. gathering lines in Glenburn field, Renville and Bottineau counties, North Dakota.
Status: Has state approval.

OVERLAND PIPELINE INC., Wichita, Kans.
Project: 4-in. gathering system in Lone Tree field, Wyo., and transmission line to connect with Plains Pipeline Division of Franklin County Coal Corp.
Status: Application before Wyoming PSC.

PHILLIPS PIPE LINE CO., Bartlesville, Okla.
Project: 75-mile 6-in. main line and 85 miles of 4-in. gathering lines to handle crude and condensate, linking Camrick field, Oklahoma, to the Phillips, Tex., refinery.
Completion: Mid-1961.

ROCK ISLAND OIL & REFINING CO., INC., 321 West Douglas Ave., Koch Building, Wichita 2, Kans.
Project: 60 miles of 6 and 7-in. from fields in Red Willow County, Nebraska, to Arapahoe Pipe Line's Colby, Kans., station.
Status: Under way.
Contractors: Gilmore Construction Co., Hays, Kans.; Plains Construction Co., Kimball, Neb.; and Barney Bridges, Ardmore, Okla.
Completion: Spring 1961.

SERVICE PIPE LINE CO., Tulsa.
Project: 60-mile, 12-in. crude line, La Plata, Mo., to Wood River, Ill.
Contractor: River Construction Co.
Completion: June 1, 1961.

SHAMROCK PIPE LINE CORP., Box 631, Amarillo, Tex.
Project: Gathering system in Hansford-Ochiltree counties, Texas, for Hansford (Marmaton), Twin (Des Moines), Share (Morrow) and Horizon (Cleveland) fields, 57 miles, 3, 4, and 6-in.
Completion: May 1, 1961.

TETON PIPE LINE CORP., 1700 Broadway, Denver 2, Colo.
Project: 45 miles of 6-in. gathering and transmission line in Dead Horse Creek, Barber Creek, and Sussex fields in Campbell and Johnson counties, Wyoming, to connect with Service Pipe Line Co. facilities at Sussex.
Status: Approved by Wyoming Public Service Commission.

U. S. Products Pipelines

BUCKEYE PIPE LINE CO., 30 Broad St., New York 4.
Project: 42 mile 8-in. extension of Midwest products system from Flint to Bay City, Mich.
Status: To start spring 1961.

CARL M. LOEB, RHOADES & CO., 42 Wall St., New York 5.
Project: 75-mile, 20-in. line from New Jersey refineries to Long Island and its two big airports, Idlewild and La Guardia.
Status: Study being made by Gulf Interstate Co., Houston, Tex.

DIXIE LPG PIPE LINE CO., (organized by Warren Petroleum Corp., Phillips Petroleum Co., Union Texas Natural Gas Co., and Tuloma Gas Products Co.), 800 Enterprise Building, Tulsa.
Project: 1,100-mile, 8 to 10-in. propane line from the Houston area to Raleigh, N. C.
Status: Service Pipe Line Co., Tulsa, selected as design and construction agent. Construction may start first quarter 1961.
Completion: Fall 1961.

EL PASO NATURAL GAS CO., El Paso, Tex.
Project: 58-mile, 6 in. LPG line from Jal, N. M., extraction plant to El Paso Natural Gas Products Co. refinery at Odessa, Tex.
Status: Planned.

GREAT LAKES PIPE LINE CO., Kansas City, Mo.
Project: Conversion of 6-in. products lines from Des Moines, Iowa, to Minneapolis and to Chicago area to tie-in with Northern Gas Products LPG line from Bushton, Kans.
Status: Planned.

HUMBLE PIPE LINE CO., Box 2220, Houston, Tex.
Project: 11 miles of 4-in. LPG line from Baytown to Mont Belvieu, Tex.
Status: Underway.
Completion: June 1961.
★ Project: 6.6 mile, 4-in. products line from Irving to Amon Carter field.
Status: Planned.
Completion: September, 1961.

INTERPROVINCIAL PIPE LINE CO., Toronto, Ont., Canada.
★ Project: 400-mile, 10-in. line from Superior, Wis., to Chicago area to deliver Alberta condensate via Interprovincial-Lakehead system.
Status: Proposed.

MID-AMERICA PIPELINE CO., Tulsa.
★ Project: 106-mile, 6-in. extension of LPG system from Whiting to Ogden, Iowa.
Status: Acquiring right-of-way.
Construction: To begin this summer, complete this fall.
★ Project: 100-mile extension from Ogden to Charles City, Iowa.
Status: Planned.
Construction: Planned for 1962.

NORTHERN GAS PRODUCTS CO., Omaha, Neb.
Project: 350-mile, 8-in. LPG line from Bushton, Kans., extraction plant to Des

PIPELINE CONSTRUCTION

Moines, Iowa, where it will connect with Great Lakes 6-in. lines to Twin Cities and to Chicago area.
Status: Planned.

SEADRIFT PIPELINE CORP., Texas City, Tex.
★ Project: 18 mile, triple line near Victoria, Texas, two 3-in. and one 4-in.
Status: Underway.
Contractor: Fowler-Tatom Construction Co.

SOUTHERN PACIFIC PIPE LINES, INC., 65 Market St., San Francisco, Calif.
Project: 70-mile 8-in. jet-fuel line from Stockton to Castle Air Force Base near Atwater, Calif.
Contractor: Eastern Pipeline Contractors, Dallas.

TEXAS EASTERN TRANSMISSION CORP., Box 1189, Houston 1, Tex.
Project: 290-mile LPG line between South Louisiana and Mont Belvieu, Tex.
Status: Planned.

TRANS-SOUTHERN PIPELINE CORP., (subsidiary of Transcontinental Gas Pipe Line Corp., Box 296, Houston).
Project: 1,000 miles of 8 to 12-in. LPG line from Mont Belvieu, southeast of Houston, to Sanford, N. C., with spurs to Demopolis, Ala.; Hattiesburg, Miss.; and an area south of Baton Rouge.
Status: Three crossings completed.
Completion: By August 1961.

WEST SHORE PIPELINE CO., Des Plaines, Ill.
Project: 285-mile products line from East Chicago refineries to Green Bay, Wis. The line will be 16-in. from East Chicago to Milwaukee and 10-in. from Milwaukee to Green Bay. A 16-in. lateral will connect line with company terminals at Jones Island.
Status: Construction will begin in June.
Completion: Scheduled before Dec. 31.

YELLOWSTONE PIPE LINE CO., Ponca City, Okla.
Project: 82-mile, 6-in. products line from Helena to Great Falls, Mont.
Completion: Dec. 1, 1961.
Contractor: R. H. Fulton & Co.

U. S. Natural Gas Pipelines

ALABAMA-TENNESSEE NATURAL GAS CO., Box 380, Florence, Ala.
Project: 3½-mile, 6-in. line to serve Armour Agricultural Chemical in Colbert County, Alabama.
Status: Planned.

ALAMO GAS SUPPLY CO., Alamo National Building, San Antonio, Tex.
Project: 166 miles of 20, 22, and 24-in. line and 101 miles of 12, 16, and 24-in. line from Texas Gulf Coast to San Antonio.

ALASKA PIPE LINE CO., Houston, Tex.
Project: 74 miles from Kenai Unit gas field to Anchorage.
Status: Construction suspended until spring 1961.
Project: Extension of Kenai-Anchorage line to Fairbanks.
Status: Alaska Pipe Line Co. has ordered economic and engineering studies to determine feasibility of such a proposal.

ALGONQUIN GAS TRANSMISSION CO., 25 Faneuil Hall Square, Boston 9, Mass.
Project: 30 miles of line in Massachusetts.
Status: Approved by FPC.

AMERICAN LOUISIANA PIPE LINE CO., Detroit, Mich.
★ Project: 25-mile, 8-in. to connect Holly Rigde field, Tensas Parish, Louisiana, to main line.
Status: Pending FPC approval.

ARKANSAS WESTERN GAS CO., Box 405, Fayetteville, Ark.
Project: New lines from Altus, Coal Hill, and Rock Creek fields to the main system.
Status: Approved by Arkansas Public Service Commission.

BORDER GAS TRANSMISSION CORP. (owned by Lehman Brothers, New York investment firm, and Rio Gas Gathering Co., 615 National Bank of Commerce Building, San Antonio 5, Tex.).
Project: Gathering lines in Starr, Zapata, Jim Hogg, Brooks, and Webb counties, Texas.
Status: Proposed.
Project: Gathering lines in Dimmit, Zavala and La Salle counties, Texas.
Status: Proposed.

CITIES SERVICE GAS CO., Box 1995, Oklahoma City 1, Okla.
Project: 10½ miles of 8-in. to connect Rounds and Porter plant with main line in Marion County, Kansas.
Status: Planned.
Project: Gathering lines in Sterling field, Comanche County, Oklahoma.
Status: Pending FPC approval.

COASTAL STATES GAS PRODUCING CO., 200 Petroleum Tower, Corpus Christi, Tex. (Subsidiaries include La Vaca Gathering Co. and South Texas Natural Gas Gathering Co.).
Project: 330 miles of various size pipe from Three Rivers area to southeast Lavaca County, Texas.
Completion: April 1, 1961.

COASTAL TRANSMISSION CO., Houston, Tex.
Project: 71 miles of various size laterals in Florida.
Status: Approved by FPC examiner.

COLORADO GAS TRANSMISSION CO., Colorado Springs, Colo.
Project: 20-inch natural gas line, approximately 250 miles, from Ignacio-Blanco area, Southwest Colorado, to Walsenburg, Pueblo and Colorado Springs, Colo.
Status: Application before Colorado PUC.

COLORADO INTERSTATE GAS CO., Box 1087, Colorado Springs, Colo.
Project: 7 miles of 20-in. in Texas Panhandle.
Status: Pending FPC approval.
Completion: 1961.
Project: 109 miles of 26-in. from Texas Panhandle to southeastern Colorado; 134 miles of 34-in. from there to Pueblo, and 107 miles of 30-in. on to Denver.
Completion: 1961.
Project: 155 miles of 34-in. from Rock Springs, Wyo., to Provo, Utah, to connect with El Paso's proposed 395-mile line to California.
Status: Approved by FPC.
Completion: 1963.
Project: 32 miles of 6-in. from Central Colorado to Trinidad.
Status: Pending FPC approval.

COLORADO OIL & GAS CORP., Denver, Colo.
Project: 402-mile line from Gubik field to Fairbanks, Alaska.
Status: Proposed.

COLORADO-WYOMING GAS CO., Box 480, Denver 1, Colo.
Project: 16½-mile, 16-in. transmission line in Adams and Boulder counties, Colorado.
Status: Pending FPC approval.
Project: 2-mile, 4-in. gas line from mainline system to Niwot, Colo.
Status: Planned.

COLUMBIA GAS SYSTEM, INC., 120 East 41 St., New York 17.
Projects: Eight loops totaling 96.9 miles, 30-in. in Kentucky, Tennessee, Mississippi and Louisiana, plus 29 miles of 12-in. gathering line from near Houma, La., to the Texaco Dog Lake field.
Status: Planned.
Completion: 1961.

COLUMBIA GULF TRANSMISSION CO., Box 683, Houston 1, Tex.
Project: 9½ miles, 10-in. gathering line, Marguerite to Ivanhoe, La.
Status: Underway.
Project: 0.9 mile, 6-in. gathering line in Terrebonne Parish, Louisiana.
Status: Under way.
Project: 97 miles of main-line loop in Kentucky, Tennessee, Mississippi, and Louisiana, and 29 miles of 12-in. lateral supply lines in Louisiana.
Status: Pending FPC approval.
Completion: 1961.

EAST TENNESSEE NATURAL GAS CO., Knoxville, Tenn.
Project: Carthage laterals 10.1 miles, 4-in. to South Carthage, Tenn., and Monterey lateral, 13.4 miles, 6-in. to Pleasant Hill, Tenn.
Status: Planned.

EL PASO GAS SUPPLY CO. (subsidiary of El Paso Natural Gas Co., Box 1492, El Paso).
Project: 228 mile, 30-in. line from Live Oak County to Sonora in Sutton County.
Status: Pending FPC approval.

EL PASO NATURAL GAS CO., Box 1492, El Paso, Tex.
Project: 52 miles of 20-in. transmission from new plant in Terrell County to a line connection in Pecos County, Texas, plus 23 miles of various-size field line.
Status: Approved by FPC.
Project: 119 miles of 30-in. Permian-San Juan crossover loop.
Status: Pending FPC approval.
Completion: 1961.
Project: 17 miles of 30-in. near Spokane, Wash.
Status: Pending FPC approval.
Completion: Not known.
Project: 34 miles of 20-in. from Puckett tie-in to Goldsmith, Tex.
Status: Pending FPC approval.
Completion: 1961.
Project: 23 miles of 20-in. from Goldsmith to the Eunice-Plains line, and 395 miles of 34-in. from Thistle, Utah, to near Las Vegas, Nev.
Completion: 1961.
Project: Loop on the San Juan mainline, involving 27½ miles of 34-in.
Status: Pending FPC approval.
Completion: Not known.
Project: About 228 miles of 30-in. from Coquat to Sonora, Tex.
Status: Pending FPC approval.
Completion: Not known.

EQUITABLE GAS CO., 420 Boulevard of the Allies, Pittsburgh, Pa.
Project: 15 miles of 16-in. in Monongalia County, West Virginia, and Greene County, Pennsylvania.
Status: Approved by FPC.
Completion: July 1961.
Project: 6 miles of 20-in. in Greene County, Pennsylvania.
Status: Approved by FPC.
Completion: July 1961.
Project: 17 miles of 20-in. in Greene and Washington counties, Pennsylvania.
Status: Approved by FPC.
Completion: October 1962.

HOUSTON TEXAS GAS & OIL CORP., Box 10400, St. Petersburg 33, Fla.
Project: 235 miles of various size laterals in Florida.
Status: Approved by FPC examiner.

KANSAS-NEBRASKA NATURAL GAS CO., INC., Hastings, Neb.
★ Project: 6.3-mile, 8-in. gas line to serve coop fertilizer plant at Hastings, Neb.
Status: Approved by FPC.

PIPELINE CONSTRUCTION

Completion: Sept. 1, 1961.

★ Project: 24.5 miles, 8-in. gas line from Huntsman to Northport, Neb.
Status: Approved by FPC.
Completion: Oct. 1, 1961.

KENTUCKY-WEST VIRGINIA GAS CO., Pittsburgh, Pa.
Project: 9.8-mile, 8-in. gathering system, Knott County, Kentucky.
Completion: By June 30, 1961.

LONE STAR GAS CO., 301 South Harwood St., Dallas 1, Tex.
Project: 14½-mile, 8-in. connection of the company's system to Pure Oil's gasoline plant in Caddo field, Oklahoma.
Status: Planned.
Project: 51.2 miles, 18-in. gas line from Parker County to Palo Pinto County, Texas.
Status: Under way.
Completion: Before June 30, 1961.
Project: Gathering lines, 6.3 miles, 16-in. in Bratch County, 16.5 miles of 8-in. and 11.6 miles of 6-in. in Palo Pinto County, 23.3 miles of 8-in. in King County and 7.6 miles of 8-in. in Smith County, Texas.
Status: Under way.
Completion: Before June 30, 1961.

LO-VACA GATHERING CO. (see parent company, Coastal States Gas Producing Co.).

MANUFACTURERS LIGHT & HEAT CO., Union Trust Building, Pittsburgh 19, Pa.
Project: 10½ miles of 24-in. Washington and Beaver counties, Pennsylvania.
Status: Planned.
Completion: September 1961.

MICHIGAN WISCONSIN PIPE LINE CO., 500 Griswold St., Detroit, Mich.
★ Project: 64.5 miles, 4/10-in. Laverne field gathering lines.
Status: Planned.
Completion: Gradually over 1961.
★ Project: 97 miles, 16/20-in. gas line from Woodward, Okla., area to Greensburg, Kans., compressor station.
Status: Before FPC.
★ Project: 68 miles, 4/10-in. gathering system, Woodward, Okla., area.
Status: Before FPC.
★ Project 26 miles, 30-in. loop in Michigan, 10 miles, 12-in. loop in Wisconsin.
Status: Pending FPC approval.
★ Project: 48 miles, 10-in. Madison lateral to Baraboo, Wis.
Status: Pending FPC approval.

MISSISSIPPI RIVER FUEL CORP., 407 North 8th Street, St. Louis 1, Mo.
Project: 5 miles of 16-in. and 15 miles of 12-in. from Collinsville, Ill., to St. Jacob, Ill.
Status: Pending FPC approval.

MONTANA-DAKOTA UTILITIES CO., Minneapolis, Minn.
Project: 106-mile, 12-in. natural gas line from Minot, N. D., to Bismarck.
Status: Before FPC.
Completion: September 1, 1961.

MONTANA POWER CO., Box 1338, Butte, Mont.
Project: 16-in. line from Carway, Alta., to Cut Bank, Mont.
Completion: 1961.

MOUNTAIN FUEL SUPPLY CO., Salt Lake City, Utah.
Project: 94.3-mile, 20-in. gas line with Natural Gas Co. from Uinta basin to near Provo, Utah.
Status: Planned.

MUSTANG FUEL CORP., Oklahoma City, Okla.
Project: 75 miles, 4½ through 12¾ in. between Piedmont and Oakwood, Okla.
Completion: June 1961.
Project: 17 miles, 10¾-in. through 12¾-in. from Newcastle to Crider, Okla.
Completion: June 1961.

NATURAL GAS PIPELINE CO. OF AMERICA, 122 South Michigan Avenue, Chicago.
Project: 50 miles of 20-in. laterals and 4.5 miles of 6-in. laterals to connect with existing 26-in. system in Jim Wells County, Texas, plus 33 miles of 10-in. laterals in the Normanna area.
Status: Temporary FPC approval.
Project: 285 miles, 30-in. and 60 miles, 36-in. loops and 22.5 miles, 8-in. laterals between Texas and Illinois.
Status: Pending FPC approval.
Completion: 1961.

NORTHERN NATURAL GAS CO., 2223 Dodge St., Omaha 1, Neb.
Project: 11.5 miles, 30-in.; 62.7 miles, 16-in. and 1.2 miles, 4-in. to serve towns of Silver Bay and Two Harbors, Mich., and Reserve Mining Co., Silver Bay.
Status: Conditionally approved by FPC.
Projects: 1,100 miles of laterals:
116 miles, 2-8 in. to 20 Minnesota towns.
Contractor: Davis Construction Co.
136 miles, 2-8 in. to 26 Minnesota towns.
Contractor: Harbert Construction Co.
426 miles, 2-19 in. to 62 Iowa towns.
Contractor: R. H. Fulton & Co.
130 miles, 2-8 in. to 25 Iowa and Nebraska towns.
Contractor: Shamrock Construction Co.
176 miles, 2-8 in. to 29 Iowa, Nebraska, South Dakota towns.
Contractor: Brodie Construction Co.
116 miles, 2-8 in. to 15 Minnesota, South Dakota towns.
Contractor: R. E. Reutzel Co.
Status: Approved by FPC.
Completion: September 1, 1961.

OHIO FUEL GAS CO., Columbus, Ohio.
Project: 24.6 miles replacement program, 5.7 miles, 12-in. to Medina and Lorain counties, 4.5 miles, 12-in. near Zanesville, 8.4 miles, 12-in. in Holmes, Tuscarawas, Carroll and Stark counties, 1 mile, 8-in. in Madison County and 2.5 miles, 18-in. in Meigs, Athens and Hocking counties, Ohio.
Status: Planned.

OKLAHOMA NATURAL GAS CO., Tulsa.
Projects: 5-mile, 12-in. line near Oklahoma City, 15 miles, 8-in. line near Eufaula and 5-mile, 12-in. line near Ponca City, Okla.
Completion: Before May 1, 1961.

PACIFIC GAS & ELECTRIC CO., 245 Market St., San Francisco, Calif.
Project: 67 miles of line from Kettleman Hills to Morro Bay, Calif.
Project: 120 miles of 34-in. looping of Topock-Milpitas main line.
Status: Planned. Pending FPC approval.
Completion: 1963.
Project: 291 miles of 36-in. from the California-Oregon border to Antioch, Calif. (Part of a 1,400-mile project to move Alberta gas to San Francisco.)
Contractor: H. C. Price Co., Bartlesville, Okla. (Bechtel Corp. San Francisco, is the engineering manager.)
Status: Under way.
Completion: System will be in use during 1961-62 winter season.

PACIFIC GAS TRANSMISSION CO., (Pacific Gas & Electric Co., San Francisco).
Project: 611 miles of 36-in. from the Canadian border at Eastport, Idaho, to the California border near Klammath Falls, Ore. (Part of a 1,400-mile project to move Alberta gas to San Francisco.)
Contractors: Western Pipe Line, Inc., Austin, Tex., and J. P. Neill & Co., Dallas, have contracts for the 465-mile southern portion. H. C. Price Co., Bartlesville, Okla., has contract for the 146-mile northern portion from Rosalia, Wash., to Eastport, Idaho. (Bechtel Corp., San Francisco, is the engineering manager.)
Status: Under way.
Completion: The system will be in use during the 1961-62 winter season.

PACIFIC LIGHTING GAS SUPPLY CO., Los Angeles, Calif.
Project: 24-mile, 16-in. gas line from Gaviota to Goleta, Calif.
Completion: August 1961.

PAN AMERICAN GAS CO., Box 591, Tulsa.
Project: 50-mile system from Pan American's terminal at Texas City to Pasadena and La Porte.
Status: Under way.

PANHANDLE EASTERN PIPE LINE CO., 120 Broadway, New York.
Project: Gathering lines, 3.85 miles of 4-in. and 3.44 miles of 6-in. in Oklahoma and 1.87 miles of 4-in. and 1.01 miles of 6-in. in Kansas.
Project: 298 miles of 30-in. loops, 43 miles of 16 to 26-in. supply laterals, and 80 miles of 6 to 12-in. sales laterals.
Status: Pending FPC approval.

PEOPLES GAS LIGHT & COKE CO., Chicago, Ill.
★ Project: 11 miles, 36-in. from Calumet station to 58th St. and Damen Ave., Chicago.
Status: Under way.
★ Project: 7½-mile, 12-in. line to test underground storage site near Mahomet, Ill.
Status: Under way.
Completion: Early May.

PEOPLES NATURAL GAS CO., Pittsburgh, Pa.
★ Project: 15.25 miles, 8 to 20-in., Allegheny and Westmoreland counties, Pennsylvania.
Status: Planned.
Completion: June-August 1961.

PHILLIPS PETROLEUM CO., Bartlesville, Okla.
Project: 16 miles of 2 to 8-in. gathering line in Eddy County, New Mexico.
Status: Planned.
Project: 17 miles of 4 to 10-in. gathering line in Midland County, Texas.
Status: Planned.

PIONEER NATURAL GAS CO., Amarillo, Tex.
Project: 21 miles of 12-in. from Sudan to Muleshoe, Tex.
Status: Pending FPC approval.
Project: 12 miles of 10-in. from Muleshoe, Tex., northward.
Status: Pending FPC approval.

PIPELINE TECHNOLOGISTS, INC., Houston, Tex.
★ Project: 50 miles various size lines, gas gathering system, Marion County, Kansas.
Completion: September 1961.

PUBLIC SERVICE CO. OF NORTH CAROLINA, Gastonia, N. C.
Project: 17½ miles of 14-in. between Stem and Roxboro, N. C.
Status: Under way.

RIO GRANDE VALLEY GAS CO., Brownsville, Tex.
Project: Transmission line extensions in Hidalgo County, Texas; 6.2 miles, 6-in.; 2.9 miles, 8-in.; and 1.3 miles, 12-in.
Completion: April 1961.

SOUTHERN CALIFORNIA GAS CO., and SOUTHERN COUNTIES GAS CO. OF CALIFORNIA, Los Angeles, Calif.
Project: 150-mile line across southern California from the Nevada border to the Los Angeles basin. Line would connect with a proposed El Paso Natural Gas Co. line extending to Rock Springs, Wyo.

PIPELINE CONSTRUCTION

Status: Pending approval of State Public Utilities Commission of California.

SOUTHERN NATURAL GAS CO., Birmingham, Ala.

★ Project: 14.4 miles, 20-in. gas line from Gwinville field to Pickens station.
Status: Pending FPC approval.
Completion: Dec. 31, 1961.

SOUTHERN UNION GAS CO., Fidelity Union Tower, Dallas 1, and **EL PASO NATURAL GAS CO.**, Box 1492, El Paso, Tex.
Project: 60-mile line from El Paso's main line near Holbrook, Ariz., to paper mill under construction near Snowflake.
Status: Planned.

SOUTHERN UNION GAS CO., Dallas, Tex.

★ Project: 22.6 mile, 8⅝-in. line connecting transmission line near Holbrook, Ariz., to point 15 miles west of Snowflake.
Completion: Aug. 1961.

★ Project: 7.2 mile, 16-in. line from Santa Junction to Alameda, N. M.
Completion: Aug. 1961.
Contractor: Mermis Construction Co.

★ Project: 5 mile, 8⅝-in. line from Southwestern Public Service Cunningham station to Lovington, N. M.
Completion: July 1961.

SOUTH GEORGIA NATURAL GAS CO., Box 791, Thomasville, Ga.
Project: 2.5 miles of laterals to serve Sylvester and Ocilla, Ga.
Status: Approved by FPC.

ST. LAWRENCE GAS CO., Ogdensburg, N. Y.
Project: 75 miles of line from Cornwall, Ont., to Ogdensburg, N. Y.
Status: Approved by FPC.

TENNESSEE-CALIFORNIA GAS TRANSMISSION CO., Box 2511, Houston, Tex.

★ Project: 105-mile, 26-in. line from Humble's King Ranch via Kleberg, Brooks and Hidalgo counties to Mexican border to connect with Tennessee-Pemex line to California. Included are 69 miles of 12-in. and smaller laterals.
Status: Pending FPC decision.

TENNESSEE GAS PIPELINE CO., a division of Tennessee Gas Transmission Co., Box 2511, Houston 1, Tex.
Project: 7.2 miles, 8-in. gathering line, Louisiana.
Status: Under construction.
Completion: Spring 1961.
Contractor: Houston Contracting Co.
Project: 16.8 miles, 12-in. gathering lines, offshore Louisiana.
Status: Approved by FPC.
Project: 12.4 miles, 12-in. gathering lines, offshore Louisiana.
Status: Approved by FPC.
Project: 9.8 miles, 10-in. gathering lines, offshore Louisiana.
Status: Pending FPC approval.
Project: 20.6 miles, 12-in. gathering lines, offshore Louisiana.
Status: Pending FPC approval.
Project: 13 miles, 20-in. gathering lines, offshore Louisiana.
Status: Pending FPC approval.
Project: 6.4 miles, 12-in. gathering lines, offshore Louisiana.
Status: Pending FPC approval.
Project: 15 miles of 12-in. gathering line offshore Louisiana.
Status: Pending FPC approval.
Project: 11½ miles of 16-in. offshore Louisiana.
Status: Pending FPC approval.
Project: 158 miles of 36-in. loop lines at various points between Kinder, La., and Centerville, Tenn.
Status: Approved by FPC.
Project: 166 miles of 36 and 30-in. loop lines at various points in Ohio and Pennsylvania.
Status: Pending FPC approval.

TENNESSEE GAS TRANSMISSION CO., Box 2511, Houston, Tex.
Project: For proposal to carry Texas gas to California via a 1,100-mile 30-in. line through Mexico, see Foreign Natural Gas listing.
Project: 292-mile line from the California-Mexican border to Los Angeles to tie in with above-mentioned line across northern Mexico.
Status: Tennessee Gas's subsidiary, California Gas Transmission Co., and Southern California Edison Co. have filed applications with California Public Utilities Commission. Also pending FPC approval.
Completion: July 1962.
Project: A line from producing fields in Texas to the Mexican-Texas border, which would connect with proposed line through northern Mexico to California.
Status: Tennessee Gas has formed a Texas subsidiary, Tennessee California Gas Transmission Co., to build and operate the Texas segment.

TEXAS EASTERN TRANSMISSION CORP., Box 1189, Houston 1, Tex.
Projects: 165 miles of 20-in. from West Monroe, La., to Kosciusko, Miss.
Status: Planned, filed with FPC.
Completion: 1961.

★ Project: 40 miles, 36-in., Station 26 to Station 27, N. J.
Status: Planned, authorized.
Completion: 1961.

★ Project: 89 miles, 30-in., Kosciusko station, Miss., and Station 21-A, Pa.
Status: Planned, filed with FPC.
Completion: 1961.

★ Project: 40 miles, 30-in., Delmont station, Pa., to Station 26, N. J.
Status: Planned, filed with FPC.
Completion: 1961.

★ Project: 45 miles, 30-in., Delmont station, Pa., to Station 26, N. J.
Status: Planned, filed with FPC.
Completion: 1962.

★ Project: 42 miles, 30 in., Kosciusko station, Miss., to Station 21-A, Pa.
Status: Planned, filed with FPC.
Completion: 1962.

★ Project: 57 miles, 14 in., Castor, La., to West Monroe, La.
Status: Planned, filed with FPC.
Completion: 1961.

★ Project: 13 miles, 14 in. Middlesex County, to Barnardsville, N. J.
Status: Planned, filed with FPC.
Completion: 1962.

★ Project: 14 miles, 12 in., Barnardsville to Roseland, N. J.
Status: Planned, filed with FPC.
Completion: 1961.

★ Project: 11 miles, 10 in., Middlesex County to Helvetta, N. J.
Status: Planned, filed with FPC.
Completion: 1961.

TEXAS GAS TRANSMISSION CORP., Box 577, Owensboro, Ky.
Projects: 146 miles of new line including 6, 26, and 30-in. loops in Kentucky, Tennessee, Mississippi, Louisiana, and Indiana, and 50 miles of 8 and 16-in. to connect five fields in Terrebonne Parish, Louisiana.

TRANSCONTINENTAL GAS PIPE LINE CORP., 3100 Travis St., Houston, Tex.
Project: 15 miles of 36-in. main-line loop to bypass reservoir of Cowan's Ford hydroelectric project on North Carolina's Catawba River.

★ Project: 25 miles, 30-in. in Texas, 24 miles, 36-in. in Louisiana; 58 miles, 36-in. in Mississippi; 75 miles, 36-in. in Alabama; 91 miles, 36-in. in Georgia, main line loops.
Status: Pending FPC approval.
Completion: 1961.

★ Project: 57 miles, 36-in. in South Carolina; 14 miles, 36-in. in North Carolina; 23 miles, 36-in. in Virginia and 23 miles, 36-in. in Maryland, main line loops.
Status: Pending FPC approval.
Completion: 1961 or 1962.

★ Project: 37 miles 3-8 in., Southeast Louisiana offshore.
Status: Pending FPC approval.
Completion: 1961 or 1962.

TRANSWESTERN PIPELINE CO., 618 First City National Bank Building, Houston 2, Tex.
Project: Gathering system in West Texas and Panhandle areas, 6 miles, 12-in.; 7 miles, 10-in.; 20 miles, 8-in.; 125 miles, 6-in.; 195 miles, 4-in.
Status: Under way.
Completion: December 1961.
Contractor: Sheehan Pipe Line Construction Co.
Project: 10-mile, 4-in. line from El Mar gasoline plant to West Texas lateral.
Status: Under way.
Completion: April 15, 1961.

TRUNKLINE GAS CO., Box 1642, Houston, Tex.
Project: 42.2 miles 30-in. loops between Louisiana and Illinois.
Status: Under way.
Project: 76 miles, 26-in. from Longville to Cow Island, La.
Status: Planned.
Project: 52 miles of 20-in. from Bayou Sale to Cow Island, La.
Status: Pending FPC approval.

UNITED GAS PIPE LINE CO., Box 1407, Shreveport 92, La.
Project: 22.37 miles, 24-in. line between Magnet-Withers and Missouri City, Tex.
Status: Under way.
Completion: May 1961.
Project: 217 miles of 30-in. from St. Mary Parish to near Monroe, La.
Status: Pending FPC approval.
Completion: Late 1961.
Project: 59 miles of 36-in. purchase lateral connecting Bastian Bay field, Louisiana.
Status: Pending FPC approval.
Completion: Fall 1961.

WASHINGTON GAS LIGHT CO., 1100 H St., NW, Washington 5, D. C.
Project: 10.99 miles, 16-in. gas line near Lanham, Mo., and Lanham to Belair, Md.
Completion: September 1961.
Project: 20.66 miles various size distribution lines, Belair, Md.
Completion: September 1961.
Project: 15.5 miles, 24-in. gas line at Hybla Valley, Va.
Completion: October 1961.
Project: 16 miles of 24-in. from near Alexandria, Va., to Prince Georges County, Maryland.
Status: Approved by FPC.

WESTERN SLOPE GAS CO., Denver, Colo.
Project: 7-mile, 4-in. gas line from Powell Park field to Meeker, Colo.; 4-mile, 4-in. line from Section 11T7SR94W to Rifle, both to be completed by July 15, and 6 miles of 4-in. gathering lines to be completed by September 1.

U. S. Miscellaneous Pipelines

LINDE CO., a division of Union Carbide Corp., 270 Park Ave., New York 17.
Project: 8-mile pipeline to deliver oxygen from new oxygen and nitrogen plant on the Houston Ship Channel to Arco Steel and Diamond Alkali.
Completion: 1961.

PIPELINE CONSTRUCTION

MONSANTO CHEMICAL CO., 800 North Lindbergh Blvd., St. Louis 66, Mo.
Project: 25-mile lines to move petrochemicals between proposed plant at Chocolate Bayou and Texas City.
Status: Planned.

SUNOLIN CHEMICAL CO., 1608 Walnut St., Philadelphia 3, Pa.
Project: Ten 8-in. chemical lines from SunOlin's ethylene-oxide plant under construction at Claymont, across the Delaware River to a point north of Penns Grove, N. J.
Status: Pllanned. To start this spring.
Completion: By late 1961.

TEXAS EASTERN TRANSMISSION CORP., Box 1189, Houston 1, Tex.
Project: 350 miles of 24-in. coal-slurry line to move West Virginia coal to electric companies in Pennsylvania, New York and New Jersey. (Texas Eastern is working jointly with Consolidation Coal Co., Pittsburgh, Pa.)
Status: Proposed.
Completion: Possibly in 1962.

Canadian Crude Oil Pipelines

BITUMINOUS OIL PIPELINE CO. (Royalite Oil Co., Ltd., Royalite Building, Calgary.)
Project: A 250-mile line from Athabasca oil sands to Edmonton.
Status: Proposed.

FEDERATED PIPE LINES, LTD., Calgary, Alberta.
★ Project: 4 miles, 4½-in. line to serve Swan Hills area, and 2 miles, 4½-in. line to serve Carson Creek.
Completion: April 1961.

HUDSON'S BAY OIL & GAS CO., LTD., 320 7th Ave., Calgary, Alta.
Project: 41 miles of 4 and 8-in. condensate line from the Waterton-Castle River area and Pincher Creek field in southwestern Alberta to Carway near the international border. The new line would then connect with Continental Pipe Line's Glacier crude system in Montana and Wyoming.
Status: Pending approval. (Hudson's plans new company, Aurora Pipe Line Co., to operate line.)

MATADOR PIPE LINE CORP., Denver, Colo.
Project: 175-mile line from Burke, Bottineau, and Renville counties, North Dakota, to Cromer, Man.
Status: Proposed. (See U. S.)

MID-CONTINENT PIPE LINES, LTD., Edmonton, Alta.
Project: 1,500 miles of 30-in. from Edmonton to Chicago. U. S. section to be owned by International Oil Pipeline Corp., New York City.
Status: Pending Canadian Board of Transport Commission approval. W. C. Gilman & Co., New York City, has made preliminary study.

RANGELAND PIPE LINE CO., Calgary.
Project: 111-mile line from Cessford field to Calgary.
Status: Pending approval of Alberta government.

TRANS-PRAIRIE PIPELINES, LTD., 12912 125 Ave., Edmonton, Alta.
Project: Expansion of gathering system in British Columbia will include 40 miles of 4-in. from Taylor to Dawson Creek; 30 miles of 6-in. from Boundary Lake to Taylor; 75 miles of 8-in. from Taylor to Milligan Creek, 11 miles of 4-in. from Milligan Creek to West Beaten; and 4 miles of 8-in. near the Taylor station.
Status: Under way.
Contractor: Banister Construction Co., Ltd., Edmonton.
Completion: By fall of 1961.

WESTERN PACIFIC PRODUCTS & CRUDE OIL PIPELINES, LTD., 1155 West Georgia St., Vancouver 5, B. C.
Project: 500-mile, 12-in. line to carry crude and liquids from Taylor, B. C., to Kamloops where it will connect with the Trans Mountain line to Vancouver.
Status: Under way.
Completion: Late 1961.

Canadian Products Pipelines

BRITAMOIL PIPE LINE CO., LTD., Box 130, Calgary, Alta.
Project: 126-mile 6-in. line from Pincher Creek to Calgary.
Status: Pending approval of the Alberta Oil and Gas Conservation Board.
Project: 64-mile 8-in. line from Dick Lake to Edmonton, Alta.
Status: Pending approval of the Alberta Oil and Gas Conservation Board.

FOOTHILLS PRODUCTS PIPE LINE LTD., (Pembina Pipe Line Co., Mannix Co., Ltd.), Calgary, Alta.
Project: 1,300 miles of 16-in. from Alberta to Chicago.
Status: Proposed. Standard Oil Co. (Ind.) will participate in the project.

HUGHENDEN PIPELINE.
Project: 125 miles from Dick Lake gasoline plant to underground storage in the Hughenden region of eastern Alberta.
Status: Pending approval of Alberta Oil and Gas Conservation Board.

HYDROCARBONS PIPELINE, LTD., 239 Sixth Ave., SW, Calgary, Alta.
Project: 503-mile, 4 to 12-in. gathering

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PIPELINE CONSTRUCTION

system, with deliveries to Calgary, Innisfail, Hughenden, and Interprovincial Pipe Line Co.
Status: Pending approval of Alberta government.

PROVINCIAL PRODUCTS PIPELINES, LTD.
Project: 700 miles of 4 to 12-in. line to pick up propane, butane, and condensates from natural-gas plants in Alberta for delivery to refineries and other plants.
Status: Pending approval of Alberta Oil and Gas Conservation Board.

ROYALITE OIL CO., LTD., Calgary, Alta.
★ Project: 25-mile, 4½-in. condensate line to join Jumping Pound and Wildcat Hills absorption plants with Valley Pipe Line near Calgary.
Status: Proposed.

WESTALTA PRODUCTS PIPELINE, LTD., (Pembina Pipe Line, Ltd., Edmonton, Alta.).
Project: 885-mile 4 to 16-in. gathering system to take natural-gas liquids from plants in Alberta for delivery to proposed Foothills trunkline to Great Lakes area.
Status: Pending approval of Alberta Board of Public Utility Commissioners. Standard Oil Co. (Ind.) will participate in the project.

Canadian Natural Gas Pipelines

ALBERTA GAS TRUNK LINE CO., LTD., Calgary, Alta.
Project: 226 miles of 36-in. and 125 miles of 30-in., plus laterals in southern Alberta including 58 miles of 22-in. and 64 miles of 16-in. (This is part of a 1,400-mile system to move Alberta gas to San Francisco.)
Contractors: Majestic Contractors, Ltd., Edmonton, has 113 miles of 36-in. from Crowsnest Pass to Priddis, 63 miles of 30-in. from Rocky Mountain House to Cynthia, and 38 miles of 22-in. lateral to the Rimbey region. Mannix Co., Ltd., Calgary, has 113 miles of 36-in. from Priddis to Rocky Mountain House. Dutton-Williams Brothers, Ltd., Calgary, has 62 miles of 30 in. from Cynthia to near Whitecourt, Alta., as well as a 20-mile, 22-in. lateral to the Whitecourt area. Piggott Construction, Ltd., Edmonton, has 64 miles of 16-in. lateral from Crowsnest Pass to Carway, Alta., on the U. S. border.
Completion: To be in use during the 1961-62 winter season.
Projects: The following laterals will be built in 1961 to tie in with the above mentioned 1,400-mile project from Alberta to San Francisco: 15 miles of 12-in. to Buck Lake, 23 miles of 22-in. to East Calgary, 15 miles of 16-in. to Carstairs, 4 miles of 8-in. to Sarcee, and 10 miles of 10-in. to Wildcat Hills. Other laterals to be built in the future will connect Kaybob, Berland River, Lovett River, and Stolberg.

ALBERTA NATURAL GAS CO., LTD. (Pacific Gas & Electric Co., San Francisco, and Westcoast Transmission, Calgary.)
Project: 108 miles of 36-in. from Crowsnest Pass across southeastern British Columbia to the U. S. border near Eastport, Idaho. (This is part of a 1,400-mile project to move gas from Alberta to San Francisco.)
Contractor: Price Poole of Canada, Ltd. (Canadian Bechtel, Inc., Toronto, is engineering manager.)
Completion: The system will be in use during the 1961-62 winter season.

CANADIAN INDUSTRIAL GAS, LTD. (formerly Ajax Petroleums, Ltd.), Derrick Building, Calgary, Alta.
Project: 28 miles of 10-in. and 4 miles of 8-in. from Morinville to Westlock Viking San field.
Status: Planned.
Completion: By September 1961.

CARTIER GAS CORP. (St. Maurice Gas Inc., and Consumers Gas Co., 19 Toronto St., Toronto.)
Project: Transmission and distribution in eastern townships and through to Quebec City in Quebec Province.
Status: Proposed.

GAS TRUNK LINE OF BRITISH COLUMBIA, LTD., Pacific Bldg., Calgary, Alta.
Project: 245-mile, 30-in. extension of Westcoast Transmission system from Taylor, B. C., to Fort Nelson.
Status: Planned. May possibly get under way early 1962.

MAGNA PIPELINE CO., LTD., Nanaimo, Vancouver Island, B. C.
Project: 53 miles of parallel 7-in. reinforced plastic pipe to serve Vancouver Island, B. C.
Status: Approved by British Columbia Public Utilities Commission.
Completion: 1963.

NORTHERN ALBERTA PIPE LINES, LTD., Edmonton, Alta.
Project: 110-mile trunk line, plus gathering system, from Lac La Biche, in McMurray vicinity, to Edmonton.
Status: Pending provincial approval.

ONTARIO NATURAL GAS STORAGE & PIPELINES, LTD., Catham, Ont.
Project: 14 miles, 10-in., 7 miles, 4-in.

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PIPELINE CONSTRUCTION

transmission line from Waterloo to Fergus, Ont., and 63 miles, 2-6-in. distribution lines.
Completion: August 1961.

QUEBEC GAS TRANSMISSION LINES, INC., 1610 Sherbrooke St. W., Montreal.
Project: 300-mile line from Montreal to Quebec City.
Status: Seeking pipeline franchise from Quebec provincial government.

SARATOGA PROCESSING CO., LTD., 406 Petroleum Building, Calgary, Alta.
Project: 67 mile gathering system (43 miles 16-in., 24 miles 4-10-in.) for Coleman, Alta., processing plant.

SASKATCHEWAN POWER CORP., Regina, Sask.
★ Project: Line from Canora to Preeceville, Sask., 20.07 miles 6-in. and 15.15 miles 4-in.
Status: Planned.

WESTCOAST TRANSMISSION CO., LTD., Calgary, Alta.
Project: 688-mile, 30-in. loop of British Columbia-Washington line.
Status: Proposed.
Project: (See Alberta Natural Gas Co., Ltd., for joint project.)

Foreign Crude Oil Pipelines

ABU DHABIE MARINE AREAS, LTD. (partly owned by British Petroleum Co., Britannic House, Finsbury Circus, London E.C. 2).
Project: 20 miles of 18-in. from offshore Persian Gulf pool to Das Island.
Completion: 1962.

ALGERIAN LINE.
Project: 330-mile line from Ohanet to Hassi Messaoud to connect with existing line to Bougie.
Contractors: First 140 miles by SOCOMAN; remainder by GREP.
Completion: June 1961.

ALGERIAN LINES.
Project: 75-mile 10-in. line to link the new oil field, El Gassi-El Agreb, with the existing Hassi Messaoud-Bougie line. SNPA is field operator.
Status: Planned.
Project: 340-mile line from Ohanet field to the Hassi Messaoud system.
Status: Approved by French Council of Ministers.

ARABIAN AMERICAN OIL CO., 505 Park Ave., New York 22.
★ Project: 27 mile, 24-in. crude line from northern Safaniya to southern Safaniya.
Status: Planned.
Completion: Second quarter, 1962.
Contractor: Aramco-Bechtel.

ARABIAN AMERICAN OIL CO.
★ Project: 6.5 mile, 6-in. LPG line from Ras Tanura refinery to Ras Tanura terminal.
Status: Under construction.
Completion: Second quarter, 1961.
Contractor: Aramco-Bechtel.

ATTOCK OIL CO., LTD., Morgah, Rawalpindi, West Pakistan.
★ Project: 55-mile, 6-in. line from Dhulian field to Morgah refinery.
Completion: July 1961.
Contractor: Motherwell Bridge Contracting and Trading Co., Ltd.

BARNABO GROUP (Italian interests).
Project: A line from Venice, Italy, to Innsbruck, Austria, which could then be extended to Munich, Germany.

BASRAH PETROLEUM CO., London, England.
★ Project: 37-mile line from Rumaila field to power plant at Basra.
Status: Contract let.
Completion: March 1962.
Contractor: SAIPEM.

COUNCIL FOR MUTUAL ECONOMIC AID (Comecon).
Project: 2,800-mile system from the Volga-Ural oil fields in Russia to East Europe satellite countries.
Status: Construction under way in Poland, Hungary, and Czechoslovakia. Construction in Russia to start soon.

ESSO STANDARD (LIBYA), INC.
Project: 100 miles of 30-in. from Zelten field to Gulf of Sirte.
Status: Under way.
Contractor: Arabian Bechtel Corp.
Completion: Mid-1961.

GERMAN LINE planned by eight German refining and marketing companies (British Petroleum, Esso, Deutsche Erdoel, Shell, Gelsenberg-Benzin, Mobil, Schloven-Chemie, and Wintershall).
Project: 155-mile, 24-in. line to Bavaria from Karlsruhe.
Status: Planned.

IRANIAN OIL EXPLORATION & PRODUCING CO.
Project: 30 miles of 20-in. and 22 miles of 16-in. looping of Agha Jari to Bander Mashur line.
Status: Planned.

IRAQ PETROLEUM CO., LTD., 214 Oxford St., London W 1, England.
Project: Looping of Kirkuk-Mediterranean system is under way on a 66-mile stretch between K-1 and K-2 stations and on an 81-mile stretch between K-3 towards the Syrian border. In Syria, a 28-mile section of 30-in. is under way.

IRAQ PETROLEUM CO.
★ Project: Two 25-mile, 32-in. crude lines to offshore loading dock in Persian Gulf.
Status: Under way.

KUWAIT OIL CO., LTD., Burgan House, London, England.
★ Project: 4 mile, 30-34-in. crude line from Ahmadi South to Ahmadi North tank farm.
Status: Under way.
Completion: Mid-1961.
★ Project: 31 mile, 24-in. crude line from Minagish to Ahmadi South tank farm.
Status: Planned.
Completion: Mid-1962.

MENE GRANDE OIL CO., Apartado 709, Caracas, Venezuela.
Project: 16-in. line at Block 11, Maracaibo.
Completion: December 1961.

OASIS OIL CO. OF LIBYA, 539 South Main St., Findlay, Ohio. (Other participants are Esso Sirte and Libyar American Oil Co.)
Project: 86 miles of 30-in. from the Dahra area of Libya to El Sider on the Mediterranean coast, and 36 miles of 20-in. feeder line from the Mabruk area to the 30-in. line.

OIL INDIA, LTD. (Burmah Oil Co. and Assam Oil Co., two-thirds, and India Government, one-third.)
Project: 720 miles of line in northeast India. This will include 250 miles of 16-in. from Nahorkatiya to Noonmati and 470 miles of 14-in. from Noonmati to Barauni.
Contractors: Mannesmann, a German firm, and SAIPEM, a member of the ENI group.
Status: Under way.
Completion: The 16-in. system is scheduled for completion late 1961.

PETROLEO BRASILEIRO S.A. (Brazil).
Project: 250-mile line from Rio de Janeiro to Belo Horizonte refinery site.
Status: Under consideration.
Project: 35 miles of 8 to 12-in. pipe from Buracica to Candeia.
Contractor: Techint, Inc., Milan, Italy.
Project: 80 miles of 24-in. to tie in to proposed Caxias refinery near Rio de Janeiro.
Status: Planned.

PHILLIPS PETROLEUM CO., Bartlesville, Okla.
Project: 14-in. line in Block 17, Lake Maracaibo, Venezuela.
Status: Planned.
Contractor: Chicago Bridge & Iron Co.

ROYAL DUTCH-SHELL.
Project: 12-mile line from Gore Bay, Australia, to Royal Dutch-Shell's Clyde refinery.
Status: Planned.
Project: 161 miles 20-in. line from Tandzung field to Balikpapan refinery, Borneo.
Status: Planned.
Contractor: Williams Brothers Overseas, Ltd., Tulsa, and John Brown, Ltd., London.
Completion: January 1, 1962.

SINCLAIR VENEZUELAN OIL CO., Apartado 1706, Caracas, Venezuela.
★ Project: 17.35 miles, 8-in. crude line from East Aguasay to south bank of Tonoro River to connect with existing 8-in. line.
Status: Planned.
Completion: Late 1961.

SNAM-SUEDPETROL, Milan, Italy.
Project: 20-in. crude line from Genoa to Ingolstadt, Austria, via Switzerland.
Status: Planned. Construction expected to begin in 1961.

SOUTH EUROPEAN PIPELINE CO. (Jersey Standard, Caltex, Shell, British Petroleum, and 12 other firms.)
Project: 419-mile, 30 in. line from Lavera, near Marseille, to Strasbourg, with 40-mile extension to Karlsruhe, Germany. This may be extended into lower Batavia with a 155-mile, 22-in. segment.
Status: Under way.
Completion: 1963.

SYRIAN LINE.
Project: About 320 miles of 6-in. from interior of Syria to link Homs refinery with various fields.
Status: Under way.
Contractor: The Italian firm, Techint.
Completion: In 1962.

UNION OF SOVIET SOCIALIST REPUBLICS.
Project: 2,315 miles of 28-in. Trans-Siberian crude-products line from Ufa and Tuimazy fields in Bashiria to Irkutsk.
Status: Under way.
(See Council for Mutual Economic Aid for information on new East Europe line.)

YACIMIENTOS PETROLIFEROS FISCALES (Argentina), Buenos Aires.
Project: 390 miles of 14-in. from fields in Neuquen Province, Argentina, to Bahia Blanca.
Status: Under way.
Project: 625 miles of 12-in. from Mendoza to San Lorenzo.
Status: Planned.

Foreign Products Pipelines

ARABIAN AMERICAN OIL CO., Dhahran, Saudi Arabia, and 505 Park Avenue, New York.
Project: 37 miles of 8-in. LPG line frrom Abqaik to 'Ain Dar.
Contractor: Aramco-Bechtel.
Completion: 1961.

CIE. FRANCAISE DE PETROLES, Paris, France.
Project: 187-mile, 8-in. condensate line from Hassi R'Mel dehydration plant to Haoud-el-Hamra station on Hassi Messaoud-Bougie crude oil line.

PIPELINE CONSTRUCTION

Status: Under way.

INDIA GOVERNMENT.
Projects: 600-mile line across northern India from Barauni to Delhi via Kanpur, Lucknow, and Allahabad; 300-mile combination crude and products line from Bombay to Bhusaval; 120-mile products line from Bombay to Poona to be extended 300 miles, later, to Hyderabad; and a 350-mile products line from Cochin to Madras via Bangalore.
Status: Proposed. Recommendation has been made to start work on three of the systems immediately, with completion in 5 years. The fourth system would be started in 1963. Which might be built first was not disclosed.

NATIONAL IRANIAN OIL CO., Tehran, Iran.
Project 360 miles of 8-in. from Rey to Meshed, Iran.
Status: Under way.
Contractor: William Brothers, Tulsa.

NORTH ATLANTIC TREATY ORGANIZATION. (Bid details from Bureau of Foreign Commerce, U. S. Department of Commerce, Washington.)
Project: 57 miles of 8-in. in Germany to Land Baden-Wuerttemberg air field.
Project: 93 miles of 6-in. in Turkey.

PETROLEOS MEXICANOS, Avenida Juarez 92-94, Mexico City, Mexico.
Project: 500-mile line from Minatitlan to Mexico City.
Status: Planned, with construction starting in 1961.
Completion: 12 to 18 months after construction starts.
Project: 270 miles of 8-in. from Torreon to Chihuahua.
Status: Under way.
Completion: September 1961.

PIPELINES OF PUERTO RICO, San Juan.
Project: 95 miles 8-in. from Penuelas to Catano.
Status: Approved by Puerto Rican Public Service Commission.

SYRIAN PIPELINE.
Project: About 310 miles from Homs to tank farms in the Damascus, Aleppo, and Latakia areas.

UNION OF SOVIET SOCIALIST REPUBLICS.
Project: 2,315 miles of 29-in. Trans-Siberian crude-products line from Ufa and Tuimazy fields in Bashiria to Irkutsk.
Status: Under way.
Project: 700 miles from Novo-Kuibyshev refinery to Bryansk.
Status: Under way.

YACIMIENTOS PETROLIFEROS FISCALES (Argentina), Buenos Aires.
Project: 652 miles of 10-in. from Lujan de Cuyo to Buenos Aires.
Status: Planned.

Foreign Natural Gas Pipelines

BASRAH PETROLEUM CO., LTD., 214 Oxford St., Oxford Circus, London W. 1, England.
Projtcts: 65 miles of 12 to 16-in. line from Zubair to Fao, Iraq.
Contractor: Mothercat Co., Ltd., Beirut, Lebanon.
Completion: April 1961 for line to Fao.

GASES NATURALES DE COLOMBIA, S.A. (Owned 50% by Colombian Petroleum Co., which is affiliated with Mobil International and Texaco, and 50% by local interest.)
Project: 140 miles of 10-in. from Cicuco field to the Caribbean port of Barranquilla.
Completion: Late 1961.

INDIA.
Project: India plans to start formal talks with Pakistan soon concerning possibility of importing natural gas from Sui field into India.
Status: Preliminary studies indicate a pipeline to Bombay might be commercially sound.

INTERNATIONAL GAS CO., Los Angeles, Calif.
Project: 1,840-mile, 30-in. gas line from Reynosa to Mexicali via Monterrey, Mazatlan, etc.
Status: Proposed.

ISRAEL GOVERNMENT and private interests.
Project: 75 miles of 16-in. to power a plant at Ashdod Yam on the Mediterranean coast.
Status: Planned.

NIOGAS.
Project: 82 miles of 8 and 10-in. to connect Traismauer and Amstetten in Austria.
Contractor: Williams Brothers, Tulsa.

PAKISTAN INDUSTRIAL DEVELPMENT CORP.
Project: 1,000-mile system to carry gas from Sui field northward from Multan to Lyalipur, Lahore, Daudkhel, Islamabad, Rawalpindi, and Wah. This would require a loop to an existing 310-mile 16-in. line from the Pakistan petroleum field to Multan.
Status: Under consideration. Technical survey has been ordered.

PAKISTAN PETROLEUM CO.
Project: 145 miles of 8-in. from Sylhet field to Daccq, East Pakistan.
Status: Proposed.

PETROLEOS MEXICANOS, Avenida Juarez 92-94, Mexico City, Mexico.
Project: A 500-mile northward extension of the newly completed gas line from Ciudad Pemex to Mexico City. It would extend to Queretaro, Salamanca, San Luis Potosi, and Guadalajara.
Status: Planned.
Project: 270 miles of 12-in. from Torreon to Chihuahua.
Status: Under way.
Completion: September 1961.
Project: For proposed Texas to California line through Mexico, see Tennessee Gas listing below.

SOC. SICILIANI METANDOTTI (SOSIM). Partners include Edison Power, Italcementi, Fiat Motor, Sicilian SGES Power, Bombrini Parodi Delfino Chemical, and Montecatini.
Project: 560 miles from Hassi R'Mel gas field, Algeria, to Cape Bon, Tunisia, 77 miles across the Sicilian Channel, into northern Italy and beyond.
Status: Engineering studies under way.

SOTHRA.
Project: A 315-mile system from Hassi R'Mel gas field in Algeria to the Mediterranean coast, including 262 miles of 24-in. trunk from Hassi R'Mel to Relizane and 20-in. from Relizane to Arzew, plus branches to Oran and Algiers.
Status: Under way.
Contractors: Groupement Entrepose - Ste. Parisienne pour l'Industrie Electrique (GREP) has contract for 200 miles from Hassi R'Mel to Tiaret. Socoman has contract for 115 miles from Tiaret to Arzew.
Completion: Spring 1961.

STANDARD - VACUUM OIL CO., New York.
Project: 60 miles of 8-in. from Radja field to Palembang, Sumatra, to supply fertilizer plant planned by the government.
Status: Planned.

TEIKOKU OIL CO. and **TOKYO GAS CO.**
Project: These two companies are negotiating a proposed 200-mile, 12-in. system to move gas from Kubiki gas field in Japan.
Status: Proposed.

TENNESSEE GAS TRANSMISSION CO., Box 2511, Houston, Tex.
Project: 1,100-mile, 30-in. line from Reynosa, near the southern tip of Texas, across Mexico to San Luis Rio Colorado, near the California border.
Status: Agreement signed by Petroleos Mexicanos and Tennessee Gas Transmission. Pemex would own the Mexican portion of the system. Pending FPC, California PUC approval.

UNION OF SOVIET SOCIALIST REPUBLICS.
Project: New line from gas fields in western Ukraine to the Polish border.
Status: USSR has signed agreement with Poland.
Project: 250-mile line from Ust-Vilyuisk field to the Siberian cities of Yakutsk and Pokrovsk. plus feeder lines to supply villages in the Lena River Valley.
Status: Planned.
Completion: Date not set yet.
Project: Two parallel, 40-in. lines, each over 1,300 miles long, from Gazli, near Bukhara, northward to Sverdlovsk and Chelyabinsk.
Status: Planned.
Project: From Tashkent to Chimkent, Dzhambul, Frunze and Alma-Ata near Chinese border.
Completion: By 1965.
Project: Line from Berezovo field southward to Sverdlovsk.
Status: Proposed.
Project: Line from Minsk northward to Baltic Sea area.
Completion: To Vilnius, Lithuania, in 1961; to Riga, Latvia, in 1962.
Project: Line from Minsk northeast to Leningrad.
Status: Proposed.
Project: 800-mile, 40-in. line from Krasnodar fields north of Caucasus Mountains to Serpukhov, south of Moscow, via Rostov and Lugansk.
Status: Under way.
Project: 310 miles of 32-in. line ringing Moscow at radius of about 50 miles.
Status: Under way.
Completion: 1962.

YACIMIENTOS PETROLIFEROS FISCALES (Argentina), Buenos Aires.
Project: 1,050-mile line from Comodoro Rivadavia to Buenos Aires with a spur to Plaza Huincul field in Neuquea Province. Line will be 26 in. to the connecting point for the Plaza Huincul link and 30 in. from the connection to Buenos Aires.
Status: Proposed.

NOTICE

SALE OF OIL AND GAS MINING LEASES, TRIBAL AND ALLOTTED INDIAN LANDS. DEPARTMENT OF THE INTERIOR, BUREAU OF INDIAN AFFAIRS, Fort Peck Indian Agency, Poplar, Montana. SEALED BIDS will be received until 9:00 A. M., Mountain Standard Time, May 2, 1961, and opened at that time at the Fort Peck Indian Agency, Poplar, Montana, for the leasing of 27 tracts of Tribal Land comprising 2,394.17 acres and 341 tracts of individually owned trust or restricted Indian lands, comprising 32,079.56 acres and 8 tracts of land subject to clarification of mineral title comprising 362.62 acres, located in Roosevelt, Sheridan, and McCone Counties, Montana, and Williams County, North Dakota, for oil and gas mining purposes. DETAILS of the lease offering and how and where to file bids may be obtained by addressing the inquiry to the Superintendent, Fort Peck Indian Agency, Poplar, Montana, or telephone Poplar, PO 8-3441.

Mr. Wayne Albertson, left, Engineering Inspector, and Leo Crowder, Koppers serviceman, inspect the pipeline coatings.

"It pays to have a Koppers serviceman on these really big pipeline jobs"

That's how Wayne Albertson, Engineering Inspector for Black & Veatch, Consulting Engineers of Kansas City, evaluated Leo Crowder's work as a Koppers serviceman on St. Paul's new gigantic pipeline project. This 90" steel waterline will carry 90 million gpd of fresh water four and one-half miles from Lake Vadnais to St. Paul's filtration plant.

Mr. Albertson stressed the importance of having a coating specialist present on the job. He said, "A pipeline is only as good as the protective coating job; and the best assurance of top-rate coating protection is to have a specialist on hand who has worked with these problems before. He can often quickly solve pipeline coating problems that might consume days of our time."

Each of the mammoth pipe sections welded together on this installation was shop coated with Bitumastic® 70-B AWWA Primer and Enamel, and wrapped by Bethlehem Steel Company before shipment to St. Paul. Following the welding operation, the pipe joints were given another heavy coating of Bitumastic 70-B AWWA Enamel and glass and felt wraps to give the joints permanent protection against corrosion.

A Koppers serviceman can show you how to get long-range corrosion protection with Bitumastic protective coatings. For more information on the complete Koppers coating line, mail the coupon or write: Koppers Company, Inc., Tar Products Division, Pittsburgh 19, Pa. District Offices: Boston, Chicago, Los Angeles, Pittsburgh, New York, Woodward, Ala., and Houston, Texas (Mavor-Kelly Co.). In Canada: Koppers Products, Ltd., Toronto, Ontario.

KOPPERS

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Koppers Company, Inc., Tar Products Division
Dept. 104-D, Pittsburgh 19, Pa.

Gentlemen:

I would like a copy of your booklet on pipeline coatings, "How Long Should A Pipeline Last?"

Name_____ Title_____

Firm_____

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City_____ Zone____ State_____

What's NEW . . . in equipment

Need more facts on the items described on these pages?

The manufacturers will gladly supply them. They're shown, with their addresses in bold type. For convenience, send this coupon to the manufacturer.

ITEM _____

_____

OIL and GAS JOURNAL

April 24, 1961

NAME _____

TITLE _____

COMPANY _____

ADDRESS _____

CITY _____

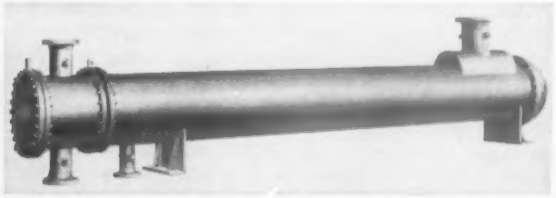
STATE _____

Control system samples, interprets

INDUSTRIAL CONTROL system now being put on the market is designed for operations which call for frequent sampling and interpretation of data, such as industrial-process study and optimization. The Model 1710 system when used as a control system can scan up to 300 instruments at regularly timed intervals and provide instructions for the adjustment of control settings, the maker says. It can also perform the calculations necessary to build a mathematical model, or description of a process.

The system is composed of the maker's Model 1711 data converter, which translates instrument readings into language understood by a computer, and the Model 1620 solid-state type of data-processing system.

The digital computer can be used independently of the control system to perform engineering and technical business-processing jobs. Source: **International Business Machines Corp., Data Processing Div., 112 E. Post Rd., White Plains, N. Y., U.S.A.**



Heat exchangers are preengineered

PREENGINEERED heat exchangers can be obtained in three tube lengths: 16, 20, and 24 ft. Shell diameters of the shell-and-tube type of heat exchangers range from 21 to 45 in. nominal i.d. in about 1-in. increments. Two, four, or six passes of the tubeside fluid are available.

Standard design pressures are 150, 300, or 450 psi. tubeside and 150, 300, or 450 psi. shellside. According to the maker, one of their standard units can be expected to meet all but the most unusual requirements.

One of the advantages claimed for the preengineered and standardized-component exchangers is that custom engineering changes are eliminated. Also certified final dimensioned drawings can be furnished with a quotation and approval of the drawings given with the purchase order. The units conform to ASME Code and TEMA-R specifications, using whichever specification is most exacting, the maker says. Source: **Griscom-Russell Co., 185 Wetmore Ave., Massillon, Ohio, U.S.A.**

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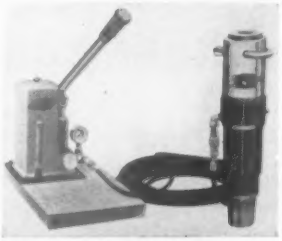
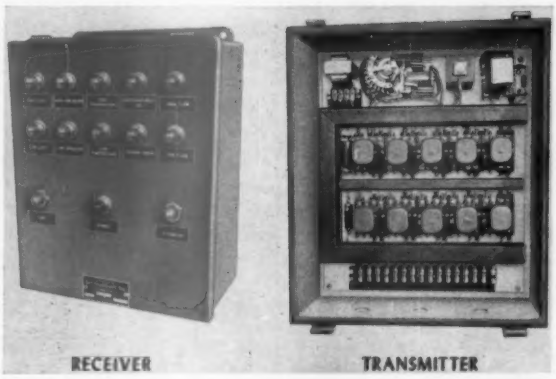


Wire-line stripper for 10,000 psi.

. . . is claimed to safely contain the pressure surge immediately following gun-perforator explosions and to also act as a blowout preventer in the event a high-pressure zone is tapped in perforating. The hydraulically operated tool strips mud and other well fluids from the line as it is removed from a well.

Two stripper types are available: Model HS5 for pressures to 5,000 psi. and Model HS10 for pressures up to 10,000 psi. Both are equipped with a hydraulic pump and a 50-ft. hose. Source: **Guiberson Corp., Box 1106, Dallas, Tex., U.S.A.**



System monitors 50 alarm signals

ALARM telemetering system provides continuous monitoring of up to 50 alarm signals. Alarms may be audible or visible. The Model AT-100 system provides transmission over a two-wire system for distances up to 20 miles using one pair of 16-gage wires.

The complete system can be equipped with up to 50 monitoring points and a matching receiver. The receiver panel contains one panel lamp for each monitoring point on the transmitter. Both the receiver and the transmitter are offered in weatherproof housings.

Information can be supplied to the transmitter from temperature indicators, level controls, pressure switches, or other controls with electrical contacts. Power to the contacts is supplied by the transmitter. Both the transmitter and the receiver require 110-volt a.c. power. Source: **Instruments, Inc., P. O. Box 556, Tulsa, Okla., U.S.A.**

Slave unit uses primary unit's power

NEW DUAL pumping unit needs one prime mover and one speed reducer to pump a dual-zone completion well. The Siamese dual unit features a slave unit attached to an API primary unit at the wrist-pin assembly.

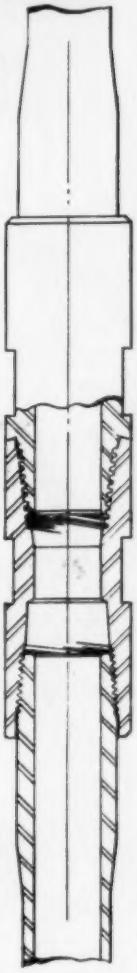
The primary unit is one of the maker's standard API pumping units equipped with a special wrist-pin assembly. The secondary or slave unit does not require either a speed reducer or cranks. Instead it secures its power from the primary unit through this special wrist-pin assembly.

The peak torque required by both units combined is normally no greater than 10% more than for one unit alone, the maker claims. This is accomplished by connecting the secondary-unit stroke sequence 90° from the primary-unit stroke sequence. This design phases the peak-torque load of the secondary unit 90° from the primary-unit peak-torque load. The result is a more uniform torque load throughout the cycle than is obtained with one unit.

The prime mover is sized for the instantaneous power output commensurate with the peak torque load imposed. The secondary unit is designed so it may be adjusted easily to other stroke lengths with-

SAVE!
with
PUMP THROUGH SUCKER RODS

- Originator of pump through sucker rod and slim-hole technique.
- Tool joint type joint prevents leakage.
- No joint has leaked since invented three years ago.
- Speed in running using only sucker rod wrench— no whipping!
- Prevents stripping jobs due to sanding.
- Strings in use in wells from 640′ to below 6,000′.
- Speed and ease of handling make the big difference (it spins!)



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out affecting the stroke length of the primary unit. By stroke adjustment and pump size, the fluid delivered to the surface may be controlled. One man can easily balance each unit individually. Once they are properly balanced, the secondary unit can be disconnected, and the primary unit will remain balanced.

The primary unit foundation is designed so either zone may be pumped with the primary unit. Source: **American Mfg. Co. of Tex., P. O. Box 7037, Fort Worth 11, Tex., U.S.A.**

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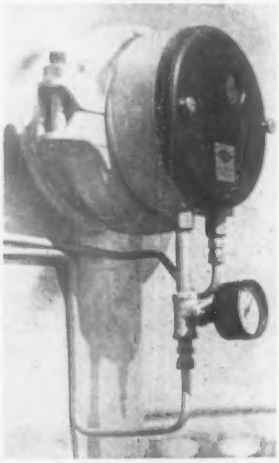


Metering-separator control . . . now being sold is designed to provide economy in the design and construction of metering separators. The P-6000 control is a single-float type. Float motion is not restricted or limited by the size of the float access opening into the vessel, the maker says.

The complete control is installed in the vessel through a short 6-in. grooved nipple welded through the side of the vessel. The float is free to swing through an arc of ±50° from the horizontal. The maker says this feature gives ample travel to meter 1 bbl. in a vertical 24-in. vessel.

The control is completely contained within the housing. The nonbleeding, snap-action type of pilot, counter, and counter actuator are factory-assembled and tested. The counter is visible through a window in the cover plate. To put a meter in operation, the maker says the only piping necessary is to connect the pilot-pressure supply to the con-

PIONEERS IN EFFICIENT DESIGN

REED COBRA

IN MUD OR AIR

Reed Cobra bits are just one example of the outstanding economies made possible by Reed's continuing program of research and development. These bits are setting phenomenal records all over the oil country in both mud and air drilling. For example—

On a West Texas well, drilling with mud below 12,000 feet, four Reed Cobra bits drilled 2,289 feet in 404½ hours. On an offset well it took 37 tooth bits to drill 2,172 feet in 558 hours. On another West Texas well a Cobra bit set an air drilling record of 3,644 feet in 103 hours.

In Pennsylvania, drilling with air, it is routine for one Reed Cobra bit to complete the hole from surface casing to TD. In this area total footage per Cobra bit regularly exceeds 7,000 feet.

Drilling with mud in East Texas in the tough Travis Peak formation Cobra bits consistently get runs up to 250 feet. Drilling with gas in Mississippi 10 Cobra bits drilled 6,850 feet in 358½ hours. In the same vicinity more than 10 times this number of tooth bits were required to drill the same footage with mud.

There is a Reed man near you. Let him give you the full story on Reed Cobra bits and the Reed Quality Line—tool joints, drill dollars and rock bits.

PENNSYLVANIA — 1 COBRA BIT, 8,352 FEET IN 134⅞ HOURS

WEST TEXAS — 1 COBRA BIT, 3,644 FEET IN 103 HOURS

FOUR CORNERS — 1 COBRA BIT, 4,102 FEET IN 134½ HOURS

MISSISSIPPI — 1 COBRA BIT, 1,317 FEET IN 51¾ HOURS

REED ROLLER BIT COMPANY

Houston 1, Texas • Export Office: Time and Life Bldg., Suite 3744 Rockefeller Center, New York 20, N. Y.—Reed Roller Bit Company (Nederland) N. V., Rooseveltstraat 6, Leiden—Reed Roller Bit Company, Ltd., 4431 6th St. S.E., Calgary, Alberta

what makes an acid treatment profitable?

In Oklahoma, a Dowell-engineered acid treatment gave the desired production increase, yet cost $1350 less than treatments used on other wells in the same field.

In Utah, Dowell-engineered acidizing boosted well production from 34 to 450 bopd in a field where other acid treatments had broken through to water.

In South Texas, a Dowell-engineered acid treatment opened up a salt water disposal well where earlier treatments had failed.

What single difference made these treatments more successful than earlier efforts?

The one difference that towered above all others is engineering. Dowell designed each treatment to fit well conditions and the operator's needs. The result was extra profit.

Dowell is well-qualified in the kind of engineered treatment design that results in excellent profit increases.

Dowell developed the Acid Guide* — a new method for designing treatments and predicting probable results. Several thousand successful acid jobs have been designed with the help of the Acid Guide within the past two years.

Dowell has an unsurpassed fund of data on formation and fluid characteristics from many fields. This information is necessary for scientific treatment planning but it is often not available from individual operators.

Dowell has a large variety of acid additives as well as collateral products and services to improve results from acid treatments.

To summarize, Dowell has the experience, the information, the acid additives, the collateral products and services, the technically-trained personnel and the laboratory facilities to design engineered acid treatments. Results have been high success ratios and satisfactory payouts on investments.

There *is* a difference in acidizing services. Dowell services and products are offered from more than 150 offices and stations in the United States, Canada, Venezuela, Argentina, Germany, France and the Sahara area. Dowell, Tulsa 1, Oklahoma.

*DOWELL SERVICE MARK

SERVICES FOR THE OIL INDUSTRY

DOWELL

DIVISION OF THE DOW CHEMICAL COMPANY

trol and to connect the pilot output to the switching valve. Source: **Parquip, Inc., P. O. Box 7496, Houston, Tex., U.S.A.**

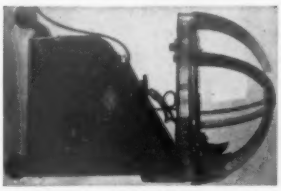
●

Relief globe of earth

. . . gives geologists and others in the petroleum industry concerned with the world scene a quick glimpse of the earth's surfaces in true relief and natural colors. Made of vinyl plastic, the Aero relief globe depicts the forest lands in green, deserts in yellow-orange, crop lands in brown, and ice caps in white.

All nations are shown on the globe as of the current date and status. The globe is constructed of two plastic hemispheres joined at the equator. It is claimed to be fireproof, breakproof, and scratchproof. Source: **Aero Service Corp., 210 Courtland, Philadelphia, Pa., U.S.A.**

●



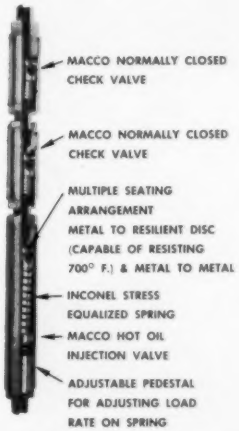
New internal lineup clamp

. . . for pipe welding uses electrohydraulic power for operation and is claimed to combine high-speed operation with extreme sturdiness and light weight. The clamp exerts pressures up to 4,000 psi. hydraulically on the full inside circumference of both ends of the pipe to be welded. This feature is claimed to eliminate the high-lows sometimes produced by the spot-pressure method.

Though designed primarily for yard welding, the clamp can be

NEW MACCO HOT OIL VALVE

Provides Economical De-Waxing Injection Directly Into Tubing At Any Known Depth


MACCO NORMALLY CLOSED CHECK VALVE
MACCO NORMALLY CLOSED CHECK VALVE
MULTIPLE SEATING ARRANGEMENT METAL TO RESILIENT DISC (CAPABLE OF RESISTING 700° F.) & METAL TO METAL
INCONEL STRESS EQUALIZED SPRING
MACCO HOT OIL INJECTION VALVE
ADJUSTABLE PEDESTAL FOR ADJUSTING LOAD RATE ON SPRING

Easily installed down-hole at any point desired for circulation of hot oil, the new MACCO Hot Oil Valve is the most economical method of combating paraffin. It makes positive treatment possible without pulling rods. Eliminates heat waste. Spring-loaded and in series with two reverse flow check valves, presure is pre-set to be greater than well pressure. Thus, hot oil can not enter casing annulus until a surface pump has built up the differential pressure. Pressure settings are not affected by hot oil or temperatures. Pressure settings are determined by individual well conditions.

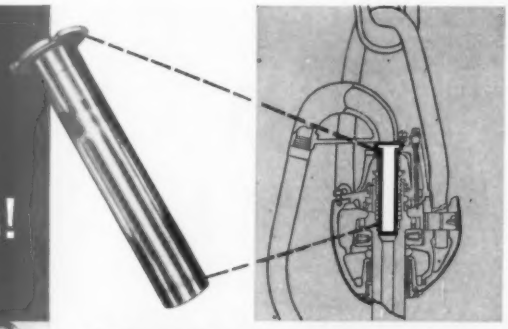
Valve and checks are constructed of stainless steel or monel for corrosion resistance. Spring is square, heavy-duty inconel wire to withstand well temperatures and corrosion.

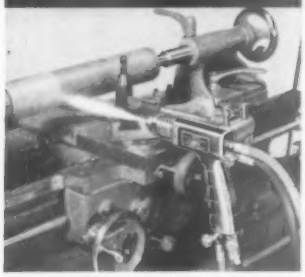
New Macco Hot Oil Valves are available in wide range of pressure ratings and two standard sizes: 1″ and 1½″ O. D. Special sizes and pressures available on request.

More information and a complete analysis of your problem is available from your Macco Distributor or by writing Macco Oil Tool Company, Inc., P. O. Box 7288, Houston 8, Texas

TIME TESTED MACCO PRODUCTION EQUIPMENT

Everlasting Wash Pipes!





The Colmonoy Spraywelder is used to hard surface lathe-mounted oil field parts. After application, alloy is torch fused creating a welded bond between overlay and base metal. Alloy in rod form is used to overlay irregular surfaces.

COLMONOY HARD SURFACING CUTS WEAR— CAN BE APPLIED TO PARTS REPEATEDLY

"Wash pipes can be hard surfaced and returned to service again and again"—that's the report of Richco Metal Spray Co., Torrance, California. Application of Colmonoy No. 6 alloy with the Spraywelder is quick, and it offers better resistance to abrasion/corrosion than chrome plated, flame hardened, or carburized surfaces. Colmonoy hard-surfaced wash pipes provide up to 3 times more service life than new pipes– yet they cost 1/3 less!

Write us about your particular abrasion / corrosion problem. We'll recommend the proper alloy and even suggest a shop doing Colmonoy work near you. Get the Colmonoy Manual and Spraywelder Catalog.

HARD-SURFACING & BRAZING ALLOYS

WALL COLMONOY CORPORATION

19345 JOHN R STREET • DETROIT 3, MICHIGAN

Buffalo • Chicago • Houston • Los Angeles • Morrisville • New York • Pittsburgh • Montreal • London, England

converted easily for operation on main lines.

The maker says the clamp can easily traverse 90° turns. A solenoid-operated brake automatically locks the clamp into place. For double jointing, the clamp has copper backup rings. The wheels are ball-bearing-equipped and made of hardened steel, though plastic wheels are available for internally coated pipe. The clamp comes in sizes for 10 to 36 in. pipe. Source: **Work-Remco Co., 8518 E. Admiral Pl., Tulsa, Okla., U.S.A.**

Faster flow-chart processing

. . . is said to be possible with a new counter for orifice flow-chart

integrators. The maker claims it can completely eliminate errors in subtraction and save considerable time in the processing of flow charts.

The Reset-Duad counter has two separate counters (A and B in the illustration) and performs two operations: totalizes each individual chart, resetting to zero after each chart is completed, and accumulates the individual and chart extensions for batch totals. Two models are available: 150 and 155. Source: **Flow Measurement Co., Inc., Daniel Bldg., Tulsa, Okla., U.S.A.**

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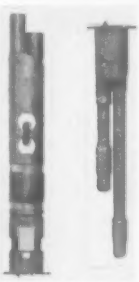
New line of packers



. . . provides the largest bores possible for combinations of tubing strings that can be run in a given casing size, the maker says. The Series HS-17 packers are a hydraulic-set, retrievable, multistring type available in sizes from 5½ to 7⅝ in. for two to five strings. Source: **Brown Oil Tools, Inc., Box 19236, Houston 24, Tex., U.S.A.**

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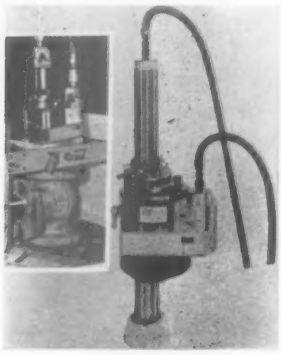


Portable grinding machine

. . . weighs only 37 lb. It's designed to be used for many grinding, machining, and boring jobs in difficult spots around the plant or field. The GIG grinding machine can be taken to the equipment or machine to be required.

According to the maker, the grinder can be set up and operated by one man. Frequently, dismantling of the equipment may not be needed. Source: **Gilmore Industrial Grinders, Inc., 6523 Eppes, Houston 17, Tex., U.S.A.**

streamlined production
CUTS COSTS . . . IMPROVES PRODUCT AT ENARDO
•
Enardo, the company who pioneered a whole new concept in lease storage equipment, has again taken a major stride forward by instituting a totally new program of engineering and management services plus a complete revitalization of production facilities. Because of these streamlined methods, Enardo Thief Hatches, Vent Valves, Burner Assemblies and other items in a complete line of oil field accessories have been lowered in price, yet maintain their unsurpassed quality. Another innovation at Enardo is the improved inventory control system. Upon receipt of an order, the item is located, packed and on its way to the customer within minutes! All this adds up to greater savings, better products and speedier deliveries when you specify Enardo equipment for your lease. Call, write or wire Enardo Manufacturing Co. for further information.
ENARDO
manufacturing co.
BOX 1647 • TULSA, OKLAHOMA

Pennsalt FLAKE CAUSTIC SODA NOW...IN 50 LB. BAGS!

Another Pennsalt Service

Pennsalt takes the lead in modern packaging of high-quality flake Caustic Soda. New 50 lb. bags were developed especially for the transportation and use of flake Caustic Soda in oil fields. These 50 lb. flake Caustic Soda bags offer six distinct advantages.

- Eliminate heavy drums and disposal problems
- Tough, waterproof and withstand normal handling
- Require 20% less storage space with higher stacking
- Easy to palletize for storing and handling economy
- Bags are easy to handle by one man
- Fast, dependable delivery from plants and offices throughout the West

For more information, write or call:

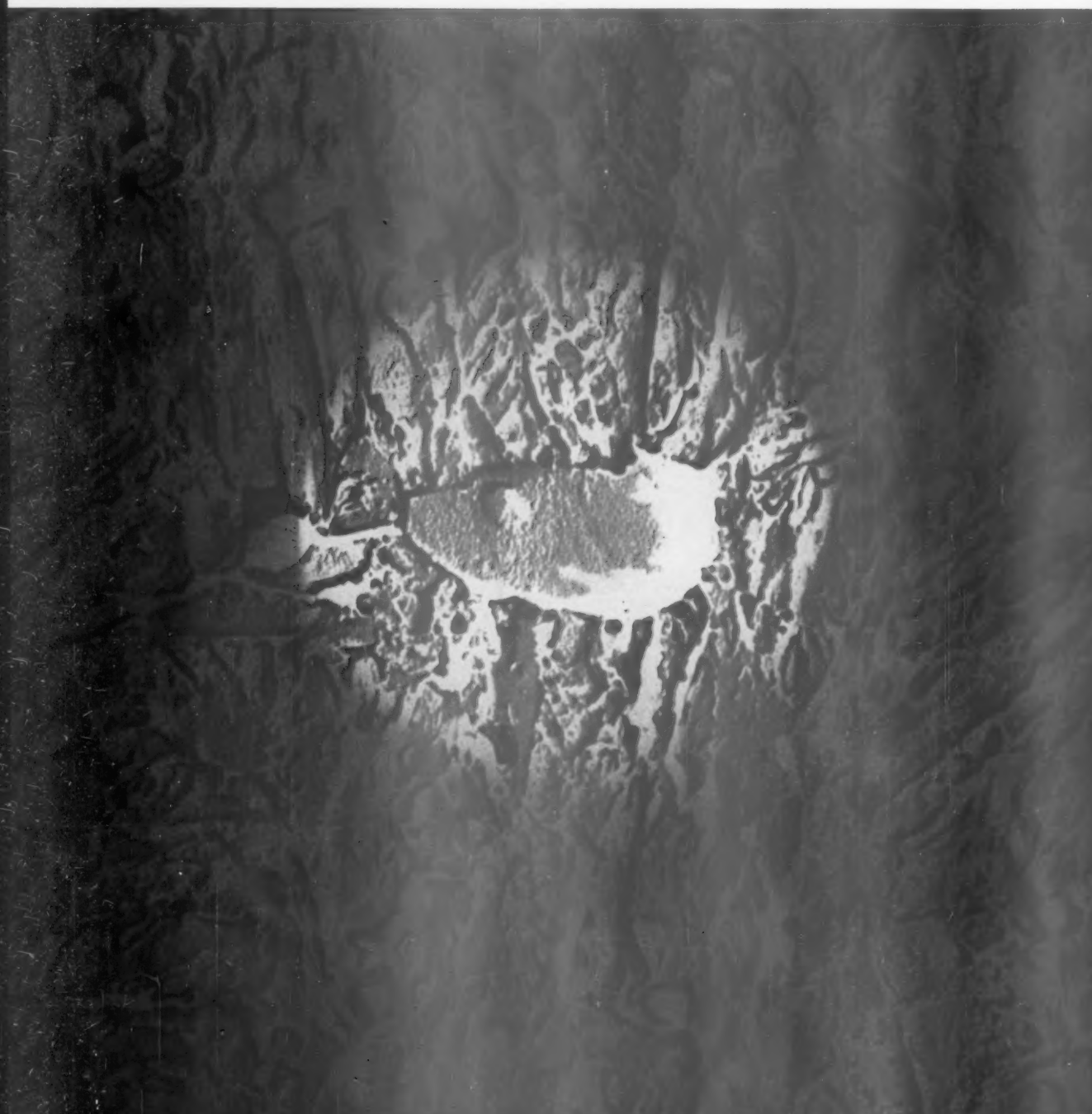
PENNSALT CHEMICALS CORPORATION
Industrial Chemicals Division - West
Tacoma 1, Washington

Offices and Plants: Los Angeles, Salt Lake City, Portland, Ore., Philadelphia, Vancouver B.C. (CRestwood 8-8441)

PENNSALT CHLORINE and CAUSTIC SODA are made at: Calvert City, Ky., Portland, Ore., Tacoma, Wash., Wyandotte, Mich., and Mexico City

Pennsalt Chemicals
ESTABLISHED 1850

PRODUCING STEEL THAT CUTS IN-THE-HOLE COST OF CASING AND TUBING



Republic looks into the microstructure of steel

To save you money, Republic is working to boost the reliability of pipe, by increasing the fatigue resistance of steel.

Metallurgists are attacking the problem of nonmetallic inclusions in steel, for example, learning how to locate, identify, track, and eliminate them.

Such an inclusion—*magnified more than 33,000 times*—is seen at left as photographed through an electron microscope.

Invisible to the naked eye, this inclusion was removed from surrounding steel by a drill small enough to put two holes, side by side, across the thickness of a human hair. It proved to be a nonmetallic substance of crystalline structure. Recurrence was *eliminated* by a slight variation in the raw material mix.

Republic is minding metal—*ridding steel of inclusions*—to cut in-the-hole cost of casing and tubing. You are assured higher fatigue resistance, higher overall quality, greater protection against costly failures.

REPUBLIC STEEL

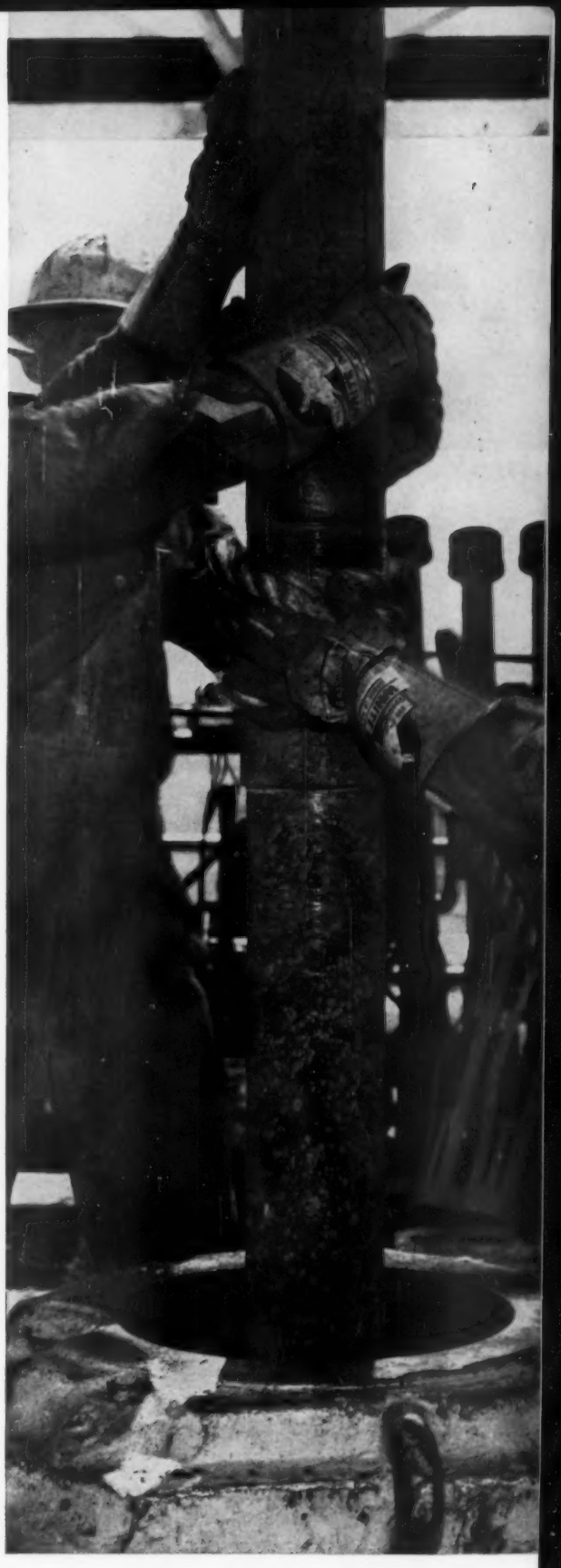
Cleveland 1, Ohio

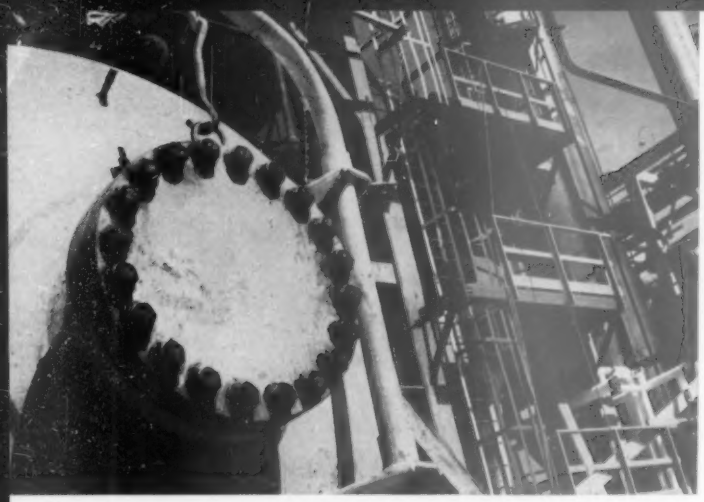
REPUBLIC HAS THE FEEL FOR MODERN STEEL

Steel

Strong, Modern, Dependable

ELECTRIC WELD AND SEAMLESS TUBING: 2⅜", 2⅞", and 3½" O.D. in H-40, J-55, or N-80. ELECTRIC WELD OR SEAMLESS CASING: 4½", 5½", 6⅝", 7", 7⅝", 8⅝", 9⅝", 10¾", and 13⅜" O.D. in H-40, J-55, N-80, or P-110. Buttress Threads available in 5½", 7", 7⅝", and 9⅝" O.D. Contact your Republic representative or mail the coupon on the following page.





FOR GREATER RELIABILITY...

PRECISION HEAT TREATMENT in the manufacture of Republic Alloy Steel Studs and Hex Nuts reduces the danger of creep, stretch, or fatigue failure. Studs for high temperature service are normally supplied in AISI 4140 Chrome-Moly Steel, heat treated to ASTM A193, designation B-7, or in designations B-14 and B-16. Nuts can be pulled up tight yet backed off quickly to meet maintenance requirements. Send for booklet listing types, sizes, and specifications.

PIONEER NATURAL GAS COMPANY selected 2" Republic SRK Plastic Pipe for the job of bringing natural gas to Washburn, Texas. A semi-rigid plastic pipe, SRK is immune to oxidation, electrolytic action, and ground chemicals. Uniform roundness and concentricity assure tighter joints . . . maximum strength at all points. Available in ½" to 8", Republic SRK is produced from virgin A.B.S. resins. Mail coupon for details.

DESIGN SMALLER CROSS SECTIONS to carry heavier loads by utilizing Republic Alloy Steels. Exceptionally high strength-to-weight ratios assure greater resistance to shock, abrasion, and fatigue. Alloy steel extends equipment life, reduces downtime, and overall costs. Republic field metallurgists help you select and apply the most desirable type—for drill bits, drill collars, tool joints, tongs, Kelly bars, blocks, sucker rod couplings, gears, shafts, and other equipment. Return coupon for data.

REPUBLIC STEEL CORPORATION
DEPT. OG-1834
1441 REPUBLIC BUILDING • CLEVELAND 1, OHIO

Please send more information on:
- ☐ Republic Casing and Tubing
- ☐ Alloy Studs and Hex Nuts
- ☐ SRK® Plastic Pipe
- ☐ Alloy Steel and Metallurgical Service

Name_____ Title_____

Company_____

Address_____

City_____ Zone____ State_____

REPUBLIC STEEL

REPUBLIC HAS THE FEEL FOR MODERN STEEL

Strong, Modern, Dependable

What's NEW

... in literature

Microwave for pipeline companies

... designated the LMR20 6-k.m.c. microwave communication system, is detailed in a new 12-page bulletin. The system consists of radio (RF equipment), multiplexing (channeling equipment), and necessary antennas, towers, buildings, etc., for each individual station. The 12-page publication presents photographs, applications, and performance specifications. Source: **Lynch Communications Systems, Inc., 695 Bryant St., San Francisco 7, Calif., U.S.A.**

Nipples installed in wellhead

... to tank lines lend a fast, accurate check on the flowing liquid while eliminating inspection valves, as explained in a four-page pamphlet. According to the literature, Clear-View nipples are made of rustproof material, resist paraffin buildup, and are not affected by salt-water and many corrosive fluids. Source: **Southwestern Plastic Pipe Co., Box 117, Mineral Wells, Tex., U.S.A.**

Inert-gas generators

... use a newly developed process known as Thermal Sub-X. A four-page literature piece contains operating principles, pictures of different units, applications, sizes, and schematic diagrams for both oil and gas-fired units. Source: **Thermal Research & Engineering Corp., Conshohocken, Pa., U.S.A.**

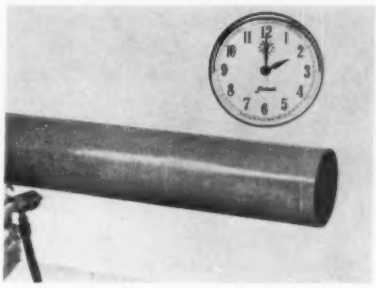
Casing and tubing

... bulletin, just made available in a 16-page form, features four pages of dimensions and properties of seamless API casing, along with plain-end liner casing. The publication also illustrates and describes the manufacture's new seamless-tube mill and details the mill's facilities and operations. Source: **Colorado Fuel & Iron Corp., Box 1920, Denver, Colo., U.S.A.**

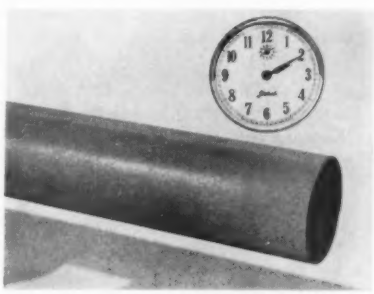
Recorders catalog

... recently published features subsurface pressure and temperature recorders and describes a 24-hour rental service. Included in the literature are gage clocks, micrometer chart readers, fishing tools, replace-

Dimetcote® is now SELF-CURING!



Only one spray coat of Dimetcote No. 4 is required. No primer! No curing solution!



Dimetcote No. 4 self-cures in a matter of minutes. Completely non-flammable and non-hazardous both during and after application. All the proven corrosion protection and weather resistance of Dimetcote No. 3 — plus self-curing.

As soon as dry, Dimetcote can be handled the same as bare steel. If severe abuse should cause minor abrasions, the zinc content cathodically prevents rust.

Dimetcote No. 4 is a self-curing maintenance version of Dimetcote No. 3, the original inorganic zinc silicate coating in use since 1938.

- **The 1-coat, 100% inorganic zinc silicate that is equal or superior to galvanizing**
- **Completely self-curing**
- **Non-flammable, non-hazardous both during and after application**
- **Excellent abrasion resistance and toughness**
- **Cathodically protects steel**
- **Insoluble in all petroleum products**

The dry film of Dimetcote No. 4 is the same as Dimetcote No. 3, which is the most widely used and most successful coating of its kind. Used alone or as a permanent primer, Dimetcote No. 4 gives steel structures the same long-lasting protection against severe atmospheric exposure!

Technical data available on request.

Amercoat® CORPORATION

Dept. CP
4809 Firestone Boulevard
South Gate, California

921 Pitner Ave.
Evanston, Ill.

111 Colgate Ave.
Buffalo, N.Y.

360 Carnegie Ave.
Kenilworth, N.J.

2404 Dennis St.
Jacksonville, Fla.

6530 Supply Row
Houston, Tex.

1348

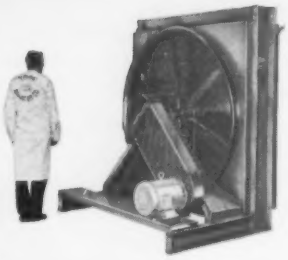
AMERCOAT NO. 99 — When required for severe chemical exposures, Dimetcote plus Amercoat No. 99 provides a revolutionary 2-COAT system!

Amercoat No. 99 is a high solids vinyl that easily attains a 6-mil dry film thickness in one airless spray coat . . . a 5-mil thickness in two coats by conventional spray methods; forms a tough, flexible film with excellent chemical and weather resistance.

Tests prove the Dimetcote/Amercoat No. 99 two-coat combination outperforms other maintenance systems—even those requiring up to 5 coats!

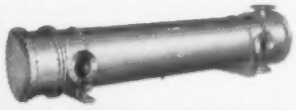
Young

BUILDS THE BEST COOLING EQUIPMENT FOR DIESEL ENGINES



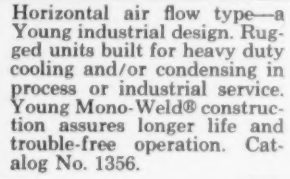
ENGINE JACKET WATER COOLERS

Horizontal air flow type—a Young industrial design. Rugged units built for heavy duty cooling and/or condensing in process or industrial service. Young Mono-Weld® construction assures longer life and trouble-free operation. Catalog No. 1356.



SHELL & TUBE HEAT EXCHANGERS

Young offers you a complete line of shell and tube, single and multi-pass, fixed and removable tube bundle units. Rugged, lightweight and compact, many models and sizes are available from stock. Fixed Tube Bundle—Catalog No. 1261. Removable Bundle—Catalog No. 1160.



SUPERCHARGER AIR COOLERS

High and low pressure intercoolers and aftercoolers are scientifically designed and laboratory tested to provide maximum heat transfer with minimum air flow restriction. Catalog No. 1652.

Write for catalog required
Dept. D-391

YOUNG RADIATOR COMPANY
RACINE, WISCONSIN
Plants at Racine, Wis. and Mattoon, Ill.

ment parts, and supplies. Source: **Kuster Co., Box 7038, Long Beach 7, Calif., U.S.A.**

Concrete treatment

. . . for industrial plants, safeguards concrete from thermal changes while repelling oils, greases, acids, alkalies, and water, as described in a new four-page bulletin obtainable now. The TK treatment literature offers charts showing chemical resistence and relative moisture loss. Source: **W. F. Macklin Co., Inc., 336 Taft St., N.E., Minneapolis 13, Minn., U.S.A.**

Pipeline sandblast

. . . process for greater flow efficiency is outlined in a new four-page literature piece available now. It tells how the process works and how pipeline sections of up to 15 miles can be cleaned. One page graphically illustrates test results. Source: **Sharman, Allen, Gay & Taylor, Inc., Box 13152, Houston, Tex., U.S.A.**

Sight-flow indicators

. . . for installation directly into pipelines to permit direct observation of fluid condition and its flow direction, are outlined in four-page Bulletin 18W. It gives construction details, dimensions, and operating limits for flapper and rotary types, with both threaded and flanged connections. Source: **Schutte & Koerting Co., Cornwells Heights, Bucks County, Pennsylvania, U.S.A.**

Hydraulic equipment

. . . for oil fields and petrochemical plants is detailed in a newly released 14-page pamphlet, free upon request. It presents photos, specifications, and applications of cylinders, valves, couplers, and pumps. Source: **Rodgers Hydraulic, Inc., 7450 Walker St., Minneapolis 26, Minn., U.S.A.**

Line-pipe production

. . . is highlighted in a new 28-page brochure recently published. It illustrates manufacturing facilities and quality control along with the maker's processes from pickling through precision forming and flash welding, mechanical expansion, and handling, loading, and shipping. Bulletin CP-92 gives tables of sizes and weights, covering wall thickness, fraction inches, and decimal inches. Weights are given in pounds per foot, per 40-ft. lengths, and per mile-ton. Source: **Tubular Div., A. O. Smith Corp., Box 2023, Milwaukee 1, Wis., U.S.A.**

Pipelayer booklet

. . . shows action and model views of five pipelayers and gives brief specifications of each. Eight-page Booklet D104 also describes power-matched welding units and clearing and ripping equipment. Source: **Caterpillar Tractor Co., 600 W. Washington St., Peoria, Ill., U.S.A.**

Professional-advancement

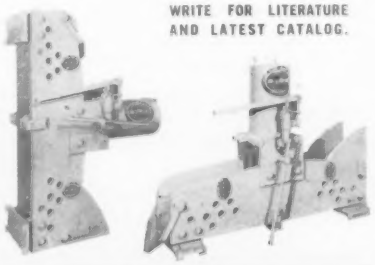
. . . booklet points out that changes in the processing industries are so rapid that the engineer must determine to follow a prescribed, disciplined course of action if he is to achieve the stature and income he desires. Pointing out that there is no magic formula for success, the booklet enumerates 14 "ground rules" for the engineer's consideration. Source: **Heat Exchanger Div., Western Supply Co., Box 1888, Tulsa, Okla., U.S.A.**

JOE STINE 100-TON PIPE & KELLY STRAIGHTENER

Efficient - Convenient - Versatile

May be set vertically on rotary table to straighten **either pipe or kelly,** or horizontally, for convenient straightening of pipe. Two quick disconnects permit use of independent hydraulic power source or hand pump. Has two speeds, with slower speed used when straightening load is high. Supporting rollers may be moved to several positions.

WRITE FOR LITERATURE AND LATEST CATALOG.



JOE STINE
INCORPORATED
6022 Cullen Boulevard
Houston 21, Texas
P. O. Box 14471
RI 7-3600

▶▶▶ Equipment Men Notes

Caterpillar Tractor Co. appoints

W. J. McBrian

. . . three executives to new positions upon the retirement of two vice presidents. The changes are effective June 1. Retiring are vice presidents Gail E. Spain, who has had administrative responsibility for foreign marketing, and Henry H. Howard, in charge of the company's Engine Division.

E. C. Chapman

L. L. Morgan

Vice president W. J. McBrian will succeed Spain and will also become president of the subsidiary companies, Caterpillar Americas and Caterpillar of Delaware. Lee L. Morgan will succeed Howard as vice president in charge of the Engine Division, and will also assume administrative responsibility for the defense-products department. E. C. Chapman, assistant sales development manager, will succeed Morgan as manager of sales development.

INTERNATIONAL GUESTS at the April meeting of the Houston Chapter of Nomads were, front row, left to right: A. R. Uliana, YPF, Buenos Aires; W. C. Robinson, Robinson Oilfield Specialties, Calgary, Alta.; Kraus Earheart, Texaco Inc., Houston, (speaker of the evening); and R. H. Buccella, YPF., Buenos Aires. Standing, from left, are: D. S. Hare, Pauley Pan American, Mexico City; Roy Bobo, consultant, Comodoro Rividavia, Argentina; Gilbert Galtie, CEP (A), Algiers; C. W. Black, Tennessee Argentina, Terra del Fuego; S. P. King, Tennessee, Terra del Fuego; and Homer Beklik, Tehran Supply, Tehran, Iran.

Continental-Emsco Co. appoints

W. Plamondon, Jr.

. . . W. N. Plamondon, Jr. to the newly created position of export sales manager, according to W. G. Sharp, manager of the export division. Plamondon will headquarter in the company's export division office in New York City. Formerly division drilling-equipment sales engineer, Plamondon began his employment with C-E in 1956 as a sales engineer in the New York office.

John W. Collins becomes prexy

. . . of Grove Valve & Regulator Co., a subsidiary of Walworth Co. and manufacturer of valves and regulators. Formerly senior vice president and chief executive officer, Collins has been with Grove 18 years, serving as an officer since 1947.

ANNUAL SALES MEETING of W. C. Norris Division of Dover Corp., held recently, was divided with half of the sales staff meeting in Tulsa and the other half in Houston. Attending the Houston session were, front row, from left: Bob McDaniels, George White, Ed Chaney, Paul Colvard, J. A. Schaff, C. L. Snelling, Hamp Brooke, Don Steward, and J. A. Getty. In the second row, from left, are: Richard L. Seale, G. W. Davidson, M. E. McKelvey, M. L. Parker, W. J. Whitaker, Gordon Shay, Don Durbin, and Homer Hill. From left in the back row are: Clint Cross, A. A. Hardy, William Brant, Dwight Maney, Don Kyle, R. W. Clifford, and D. P. Hagaman.

Joe Donald Maruska is manager

. . . of Mid-Continent Supply Co.'s store at Pincher Creek, Alta., in the oil fields of western Canada. He was formerly field salesman at the same location. Maruska joined Mid-Continent in 1955 as a storeman at Drayton Valley, Alta. He was promoted to field salesman the next year and was transferred to Pincher Creek last winter.

N. S. Kendall assumes duties

. . . as assistant to Tyson Smith, president of Smith Industries, Inc., of Houston. Kendall was previously associated with Jamar-Olmen Co., where he served as secretary and general manager for 14 years. Prior

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Reader Service Department

The OIL and GAS JOURNAL

P. O. Box 1260, Tulsa 1, Okla.

to that he worked with Platt Rogers, Inc. as general superintendent, and with Naess & Murphy, architects and engineers.

Earl G. Hoff is elected president

...of Walker Well Heads, Inc. at a board of directors' meeting held recently at the company offices in Tulsa. Hoff has been with the Walker firm since 1957 and previously was employed by Hinderliter Tool Co. and Texaco Inc. Other officers elected were Eugene Owen, vice president and secretary, and Mrs. Alta Kennedy, assistant treasurer.

Earl G. Hoff

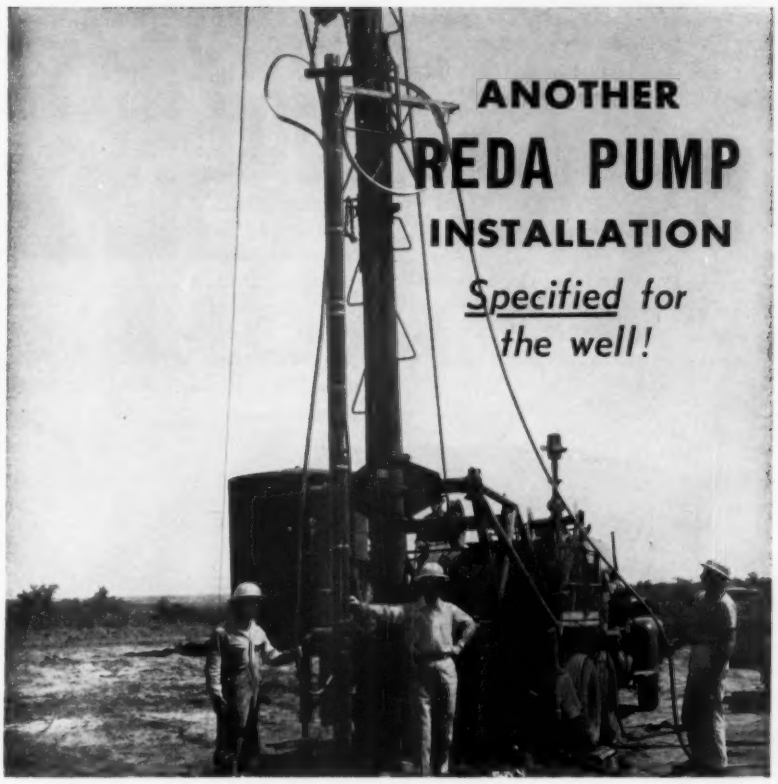
Martin-Decker holds open house

... and features the company's new scientifically controlled calibration laboratory. Also on display were other facilities and products including scales and gages.

PROTOTYPE ground-support fuel system for the Atlas Missile designated COPS-1 has been completed by Warner Lewis Co., division of Fram Corp., Tulsa. This development contract, received from Convair Astronautics Division, General Dynamics Corp., San Diego, calls for eight of these purification systems to provide complete contaminant and moisture removal from RP-1 rocket fuel. Major components of the units include a Warner Lewis two-stage separator/filter, desiccant dehydrators, valve system for pressure and flow control, and a contaminant detector which will monitor the quality of the fuel being dispensed from the vehicle. Flow rate through the system is 300 g.p.m.

Security Engineering makes

...a number of personnel shifts within its sales organization, announces Ken L. Byerly, vice president for domestic sales. William B. Thomas has been promoted to West Texas division manager, taking over



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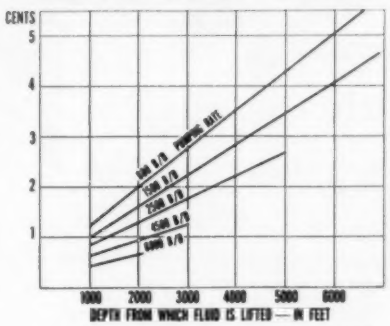

*Included: Electric Energy (10 Mills Per KWH), Run and Pull, Repairs, Upkeep, Transportation, Labor and Amortization (5 Yrs.)

Chart "A"

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the new post after a tenure as special sales representative in Dallas.

Mack Harlan is now district manager at Odessa and E. R. Beasley is office manager of the West Texas division. Prior to these assignments, Harlan was manager at Carmi, Ill., and Beasley was sales staff assistant at the company's headquarters in Dallas.

In another move, Security appointed D. M. Harrell as manager of the Corpus Christi district. He was district manager at Oklahoma City.

Elmer E. Rubac named president

E. E. Rubac

. . . of American Iron & Machine Works Co., Inc., Oklahoma City manufacturer of oil-well-drilling equipment and a subsidiary of American Machine & Foundry Co. He succeeds M. G. McCool who resigned. Executive vice president of American Iron since 1951, Rubac joined the company in the billing department in 1937.

Following a tour of army duty during WWII, he returned to the company in 1945 as assistant to the sales manager. Rubac served as assistant to the general manager from 1946 to 1949, became a vice president in 1949, and executive vice president in 1951.

National Supply Div. transfers

. . . two sales representatives of its southern region to new locations, and promotes two store employes to positions of field salesmen. Jack H. Romans has been transferred from Lubbock to Dallas, and Robert E. Sikes from Dallas to San Antonio. Sherrod D. Dunn, of the Abilene, Tex. store will have field duties at Snyder, Tex., and Sherwin R. Papillon, of the Jennings, La. store, will have field work in the same area.

Ronald L. Vingoe is appointed

. . . chief field engineer of the tubular department, National Supply Division, Armco Steel Corp. With headquarters in Dallas, he succeeds Charles C. Brush who has been named field engineer at Houston. Vingoe started at National's Ambridge, Pa., plant in 1952. He has served as assistant plant metallurgical engineer, plant metallurgical engineer, and assistant superintendent of inspection.

The new TYSCO skid-mounted stage separation units are compact and easy to move. No need to rig gin poles. The complete unit can be quickly snaked off the truck and into position with the winch line. This means less chance of handling damage, and a big time saving. Field hook-up is quick and easy. The unit comes complete with drain, back pressure and dump valves piped in place. Relief valves and safety heads are mounted. Gauge glasses and copper tubing can be quickly installed. Then connect your inlet and outlet lines and the unit is in operation.

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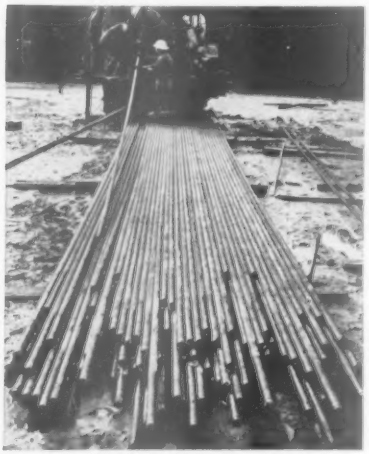

MACARONI TUBING—More than 10,000 ft. of 1¼-in. N-80 macaroni tubing was used by Petro-Atlas Inc. to save this well near Haynesville, La. The macaroni, furnished by Jones & Laughlin Supply Division, was used with a junk basket as drill pipe to clean out the well. The operation resulted in the well again flowing at the rate of 125 bbl. per day.

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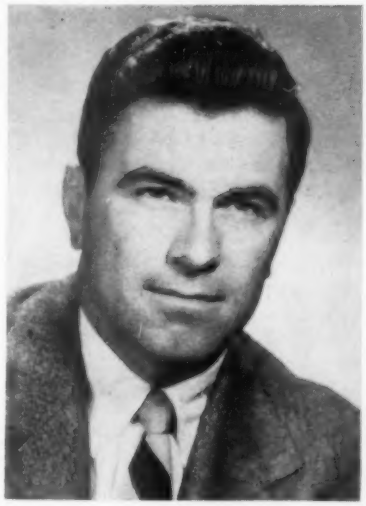
Firm names new Gulf Coast manager

AN ADDITION to the staff of Global Marine Exploration Co. has been announced by R. F. Bauer, president. John H. Atwood will represent Global in the Gulf Coast area, operating from Houston, as Gulf Coast manager.

The firm is an offshore drilling contractor, specializing in floating drilling vessels. In addition, it offers engineering services in design and construction of various types of marine and sea-floor installations, anchors, platforms, well installations, and storage facilities.

Atwood has been active in Gulf Coast offshore drilling operations for the past 6 years with Warren Bradshaw Exploration Co. and Sohio Petroleum Co. Upon graduation from Purdue University with a mechanical-engineering degree, he spent 2 years as a halfback with the New York Giants. Following this stint, he was a roustabout and roughneck for Sohio in the Illinois basin and in southern Oklahoma. After 5 years as a Sohio drilling engineer in Oklahoma, he joined Warren Bradshaw as chief drilling engineer. In this period, he watched the operations of 30 rigs which were spread from Canada to the Gulf Coast. In 1957, he returned to Sohio to supervise offshore operations in New Orleans and Houston. During an 18-month period, he observed and studied offshore drilling methods and equipment. Before joining Global, he was supervising all Sohio drilling operations, foreign and domestic.



J. H. Atwood

Presently Global owns and operates three floating drilling vessels along with miscellaneous auxiliary facilities on the West Coast and Great Lakes areas. The largest vessel of Global's fleet, the CUSS 1, is ready to test equipment and drilling methods in 12,000 ft. of water, preparatory to drilling the Mohole. This vessels has drilled more than 225,000 ft. of hole in varying depths of water from 45 to 350 ft. The company has a staff of drilling and marine engineers, naval architects, oceanographers, and design engineers in its Los Angeles office.

Dallas safety conference slated

THE THIRTEENTH annual AAODC Drilling Industry Safety Clinic will be held May 18 and 19 at the Baker Hotel in Dallas. Highlighting the program will be panel discussions to be held in the Crystal Ballroom.

Following registration in the Mezzanine from 8 to 9:30 a.m.; the program will begin with Arthur B. Buzzini of Buzzini Drilling Co., San Antonio, presiding. Following the invocation by A. Earl White, Mustang Drilling Co., Tyler, Tex., John J. Moran of Moran Bros., Inc., Wichita Falls, will deliver the AAODC presidential address.

At 10 a.m. a talk entitled "Psychological Aspects of Safety" will be given by Louie E. Throgmorton, Republic National Life Insurance Co., Dallas.

The first panel discussion will begin at 10:30 a.m. with R. W. Horton of Moran Bros. as moderator. "Rigging Up" will be discussed by Warren Hirsch of Delta Drilling Co., Tyler, Tex. "Making Trip" will

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be presented by G. W. Hutcheson of Great Western Drilling Co., Midland. The third part of the panel topic is "Running Casing" which will be covered by Jack L. Taylor, Wheless Drilling Co., Shreveport.

The luncheon meeting will begin at 12:15 with Warren A. Hirsch presiding. The first talk on the afternoon program at 1:30 is "How a Small Contractor Conquered His Safety Problems" by A. Earl White, with John S. Jackson, Rowan Drilling Co., Fort Worth, presiding.

At 2 p.m. a panel discussion entitled "Contractor Approach to a Safety Program" will cover the topics of "Personnel," "What Works in Basic Safety Programs," and "Pitfalls of a Safety Program." Participating in the panel will be K. K. Swanson of Moran Bros., P. M. Wheeler of Fleet Drilling Co., Ada, Okla., and Ned E. Simes of Penrod Drilling Co., Dallas.

I. J. Fisher, Jr., of AAODC will talk on "AAODC Safety Services" at 4 p.m. A fellowship hour will follow from 5 to 6 p.m.

The Friday program will start at 9:30 a.m. with A. D. Johnson of Texaco Inc., Houma, La., presiding in the morning and G. W. Hutcheson presiding in the afternoon. Arthur P. Buzzini will preside over the 12:15 luncheon meeting.

The first topic covered in the morning will be "Communications" by L. J. Whetsel of Texaco, Houston, followed by "Communication—A Potential Hazard," a demonstration by L. K. Jonas, Texas A & M College. Closing the morning session will be a paper at 10:45 on "Safety in Gaseous Drilling" given by Gordon Jackson, Well Completions, Inc., Denver.

In the afternoon starting at 1:30, "Safety in the Sixties" will be discussed by Joseph M. Shelton of AAODC, and W. P. Clements, Jr., of Southwestern Drilling Corp., Dallas. The meeting's final talk will be given at 3 p.m. by John B. Mead, Marsh & McLennan, New Orleans.

New Alaska wildcat begins

A new venture has been started by Richfield, BP Exploration, and Sinclair at the 1 Duktoth River. Location is near the Gulf of Alaska 11 miles northwest of the Cape Yakataga FAA installation.

RIG REPORT

FOR SERVICING AND WORKOVER

. . . In the fields of South Texas, this Ideco Drive-In Rambler is equipped with an Ideco DUAL SPEED SYSTEM which saves 30 to 50 percent of the time usually required to pull or run tubing. On this location 185 stands were run in the hole in 45 minutes. Drive-In Ramblers equipped with the Dual Speed System are the answer to faster, more efficient, and more economical well servicing and workover operations. The Dual Speed System can be installed on most types of Ideco servicing and workover rigs.

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(17-STATE AREA)

Wells Productive of Some Oil or Gas in Year of Discovery					Wells Discovering Profitable Fields Based on 6 Years of Development History		
Year of Discovery	Total New-Field Wildcats	Number Productive of Some Oil or Gas	Per Cent Productive	Ratio of Productive Wells	Number of A-B-C-D Reserve Fields	Per cent of A-B-C-D Fields to Total New Field Wildcats	Ratio of A-B-C-D Fields to Total New Field Wildcats
1944	3,014	330	10.9	1 - 9.1	84	2.79	1 - 36
1945	2,913	335	11.5	1 - 8.7	71	2.44	1 - 41
1946	2,995	313	10.5	1 - 9.6	73	2.44	1 - 41
1947	3,325	378	11.4	1 - 8.8	78	2.35	1 - 43
1948	4,087	471	11.5	1 - 8.7	92	2.25	1 - 44
1949	4,238	479	11.3	1 - 8.8	108	2.55	1 - 39
1950	5,149	577	11.2	1 - 8.9	125	2.43	1 - 41
1951	6,044	666	11.0	1 - 9.1	127	2.10	1 - 48
1952	6,440	720	11.2	1 - 8.9	118	1.83	1 - 55
1953	6,634	747	11.3	1 - 8.9	156	2.36	1 - 43
1954	7,033	875	12.4	1 - 8.0	117	1.66	1 - 60
11-Year Period	51,872	5,891	11.356	1 - 8.8	1,149	2.22	1 - 45

Will success foil rock hunters?

BY FRANK J. GARDNER

WHO'D EVER THINK that "success" is a bad word? Well, it can be, and it has been for at least 16 years, according to the AAPG Committee on Statistics of Exploratory Drilling.

Because of its use of the words "Successful New-Field Wildcat" and "Success Per Cent" in its annual tabulations, the committee feels it has misled some Ivy League experts on oil. In the report covering 1960 drilling, to be published in next June's AAPG Bulletin, the words will not appear.

In a Journally Speaking column headed "Pennies from Harvard" (OGJ, Feb. 13, 1961, p. 41) Henry Ralph told a tale of one professor who belittled the risk involved in wildcatting, based on the annual AAPG report. It's true that this report for 16 years has indicated that one out of nine wildcats has been successful, but the good professor chose to ignore another part of the report which, for the past 11 years, has tried to point out that actual success must be measured in another way—performance.

One of the vital tables in the report lists numbers of successful wildcats which can still be called successful after 6 years of development history. And for the 11-year period, the ratio of success to failure in wildcat drilling, as revealed by this table, averages 1 in 45 rather than 1 in 9. In 1954, the latest year for which a 6-year development history can be recorded, success hit an all-time low of 1 in 60.

The profitability scoreboard as it will appear in the June Bulletin of the AAPG, is shown above. It will not be exactly as shown here, for the "scoreboard" tag is our own, and some of the subtitles have been cropped for space, but the figures are all there. Note that the words "success" or "successful" are nowhere to be seen. Rather, the words "productive of some oil or gas" will be substituted.

The only successes, really, are those tabulated in the first column of the table on the right—the "A-B-C-D-Reserve Fields." The smallest field to qualify as profitable is a "D" reserve of 1 million barrels of oil or 6 billion cubic feet of gas. A "C" reserve is 10 to 25 million barrels or its gas equivalent, while the "B" reserve is 25 to 50 million barrels, and an "A" reserve is 50 million or more.

"We're not trying to be pessimistic—just realistic," says the AAPG Committee. Its chairman, J. Ben Carsey of Humble Oil & Refining Co., feels that the figures must be fully understood by those inside and outside the industry if they are to be of any benefit.

It all reminds us of a speech by George C. Hardin, Jr., Houston consulting geologist, when he appeared before a group of Gulf Coast geologists in 1959. His subject was "Beware the Semantic Trap"; its theme was that different words mean different things to different people. To some people, success is a great word; to others, it's a real stinker.

Arkoma basin moves quickly into contention for gas-finding honors

The new age of gas is upon us. Once a byproduct of exploration, gas is now a prime target for the drill. With this new surge of gas exploration comes the arrival of new gas basins. We've seen the advent of the Green River, deep Delaware, western Anadarko, Sacramento Valley—now watch the rise of Arkoma.

IN A SHORT SPAN of 2 years the Arkoma basin has joined the list of gas-hunting grounds.

Gas has been produced in the basin for half a century, but things didn't get going in southeastern Oklahoma and western Arkansas until 1959. New interest in gas production and exploration has given rise to a spirited drilling and exploration campaign throughout the two-state basin. Since the early 1900's 89 gas fields have been tapped in the Arkansas Valley region, stretching all the way from Atoka in Oklahoma to east of Russellville in Arkansas. This gas production was never taken seriously until 2 years ago. In the past 15 months eight significant gas fields have found their way onto gas records in Oklahoma; also eight new finds have been recorded on the Arkansas side.

Extensive drilling. There are two dozen tests going on the Oklahoma side of Arkoma. This represents 25% of all Oklahoma wildcatting, for 12 wildcats are drilling in southeastern counties—48 drilling in the state over-all.

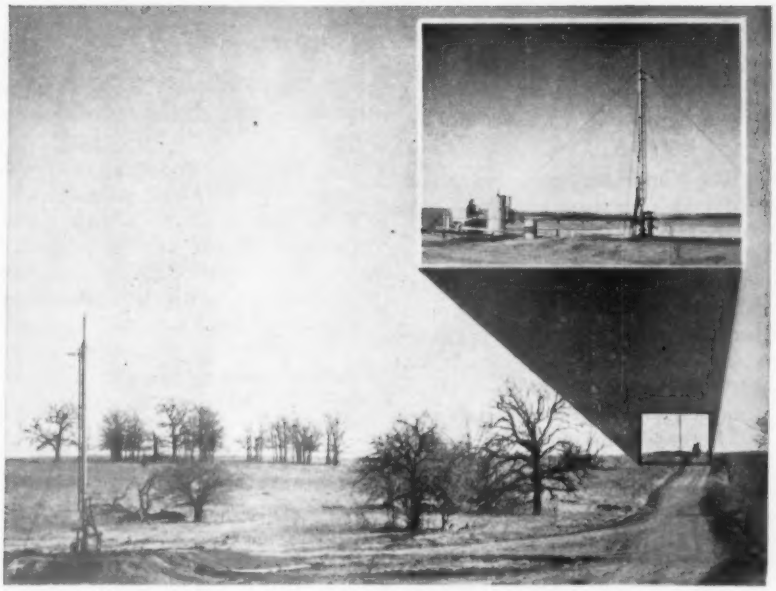
In Arkansas, 80%, or 4 out of 5 of the current wildcats drilling in the state, are in Arkoma. Out of the 20 field wells drilling in the entire state of Arkansas, 11 of them are working in Arkoma—55%. This active drilling list in Arkoma is significant when you consider that 2 years ago the drilling reports had practically no wells reported in the basin.

Geologists tour. Last week, nearly 200 geologists from throughout the Southwest conducted a field trip through the Arkoma basin and the North-Central Ouachita Mountains. The trip, sponsored by the Fort Smith and Tulsa geological societies, took the group through the complex Ouachita Mountain province, long overlooked by geologists and the drill, but emphasized the up-and-coming Arkoma basin. The two provinces were not isolated from one another, however, for they are contiguous, with much to be learned about one from the other. Even with the recent gas discoveries in the deeper Pennsylvanian zones around the basin fresh in mind, the caravan returned to Fort Smith knowing that Arkoma's future is far from being solved. The field trip covered an area containing 21 Arkoma basin gas fields. Some of them are as old as 1901 (Mansfield). All produce from Pennsylvanian. New fields in recent months that stirred new thinking about this old-but-new province are: Potato Hills field, Latimer County, Sinclair 1 Reneau; Midwest Oil Corp. 1 Orr, dual discovery in Old Red Oak-Norris field, Latimer County; Stephens Production Co. 3 Redland Ranch, Sequoyah County, new discovery in Old Redland field; Apache 1 Williams unit, Haskell County, New Northwest Kinta field; Ambassador 1 Williams unit, Latimer County, new discovery in Old Wilburton field; LeFlore County G&E-Humble 1 Holt, Haskell County, New Southwest Cartersville field; Midwest Oil Corp. 1 Morris, LeFlore County, new discovery in Rock Island field; and Mobil Oil Co. 1 Quinton unit, Haskell County, New South Lewisville field. All of these had Spiro production except Midwest Oil Corp. 1 Morris with Atoka gas and Sinclair 1 Reneau with Bigfork-Middle Ordovician gas. The Potato Hills discovery (1 Reneau) gave the Ouachita province its first production.

The most active field-development areas in and around the above discoveries are: Red Oak-Norris with six wells drilling (Thus far four have indicated gas in the Red Oak and Spiro); Old Redland with one test recently completed diagonally offsetting the discovery well with Spiro gas; Northwest Kinta field with four tests completed offsetting the discovery well; and Potato Hills with a confirmation test now drilling.

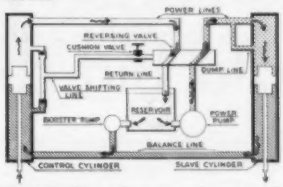
Long way to go. The field trip through Arkoma and the Ouachita Mountains stirred much-needed interest and the need for more knowledge of this highly complex and hard-to-drill basin. Many stratigraphic problems have arisen in drilling the basin. Many more will arise in the future. Stratigraphy rules the basin's gas accumulations. More about Arkoma's secrets has been unearthed in the past 2 years than in the entire 50 years it has been producing gas. The next two years may quadruple this accrued knowledge. Despite its drawbacks most agree that Arkoma can't be overlooked in the oncoming surge of gas exploration.

—John C. McCaslin



OKLAHOMA offset installation of EOT-Johnston Rod-Counterbalanced pumping units.

How the EOT-Johnston unit operates:



HYDRAULIC flow diagram showing Control Piston on upstroke.

In the illustration above the piston appears to be lifting only the fluid weight on the net plunger area with the rod weights cancelling each other. However, the buoyancy in the downstroke well will subtract from the counterbalancing effect of the rods so that the upstroke load is actually the fluid weight on gross plunger area. This is in contrast to a single counterbalanced unit where the effective load is one-half the gross plunger load, but the EOT-Johnston unit is pumping **two** wells.

Hydraulic units cut capital outlay 50%

- EOT-Johnston Rod-Counterbalanced units save more than $13,000 on 9500 ft. dual-zone offset wells in Oklahoma.

An Oklahoma oil operator selected the hydraulic method offered by Engineered Oil Tools, Inc. to pump his offset wells, effecting a saving of more than $13,000 on two EOT-Johnston Rod-Counterbalanced hydraulic pumping units over an alternate proposal. These pumping wells are located near Healdton, Oklahoma.

Operating conditions: This installation, shown in the photograph, involves two wells on 40 acre spacing. Each well has a dual-zone pump, making a total of **four** zones pumped with the two rod strings. The zones are at 9000 and 9500 ft. The rated polish rod load is 29,000 lbs. and the units are operating at three strokes per minute on a 16-ft. stroke, producing at a displacement rate of about 115 barrels per day from each well. The connecting pipe line is 3½″ O.D. by .125″ wall electric resistance welded, X-42 grade. Total installed price of units (pipe, engine, hydraulic oil and all surface equipment except wellhead) was approximately $12,800 for the two wells.

Alternate equipment considered was beam units having a 100-inch stroke, 27,000 lb. beam rating, 320,000 in.-lb. gear box, operating at six strokes per minute. The installed price of this equipment was approximately $13,250 **each** as compared to the $12,800 for **both** wells equipped with the EOT-Johnston units. This Oklahoma operator is pumping his two wells for the price of one — a substantial saving on capital outlay.

Simplicity of design: The EOT-Johnston unit was engineered to meet field operations and maintenance requirements. There is no complicated starting procedure, either. It is only necessary to start the pumping unit's power package. The unit automatically pre-charges itself, begins operation, and once in operation times itself and keeps the two cylinder units in phase automatically. Actually the operation and maintenance of the EOT-Johnston Rod-Counterbalanced hydraulic pumping unit is no more complicated than that of an automobile with an automatic transmission. Should the unit require more than routine field servicing, Engineered Oil Tools, Inc. has a service staff and spare parts available in all major operating areas.

Maintenance consists of checking the oil level and oil filter and tightening the packing occasionally.

The Balance Pressure is that required to lift rod weight plus net fluid weight in the upstroke well, plus acceleration load. The Balance System is not a dynamic circuit, as the hydraulic fluid simply "washes" back and forth, in a U-tube effect.

The speed of shifting is governed by the setting of the Cushion Valve, which restricts the flow into Reversing Valve. This allows a gradual deceleration of the Control Piston, and Slave Piston also, as the latter is governed entirely by the action of Control Piston.

Investigate the economics of pumping your wells with an EOT-Johnston Rod-Counterbalanced hydraulic pumping unit. Pump dual completions . . . offset wells up to 160 acre spacing with one power unit . . . and save up to 50% over other rod pumping methods.

EOT has a new fact-filled catalog on the Rod-Counterbalanced pumping unit. If you would like more information to save your company production dollars, write or call: Sales Department, Engineered Oil Tools, Inc., 1710 Burnett, Houston, Texas. Complete information will be sent you by return mail.

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Cambrian rocks may hold big reserves

BY JOHN C. McCASLIN
District Editor

THE OLDEST sedimentary rocks, those of Cambrian age, produce less oil and have been less explored than any other system on the geologic scale.

Cambrian rocks, on the other hand, are widely distributed throughout the world. North America is the only continent having pure Cambrian production. There are many prolific oil areas in other parts of the world having Cambro-Ordovician production, but the Cambrian itself remains untouched.

The Cambrian few. Six states and one Canadian province have fields producing Cambrian oil and gas. The oldest known Cambrian field is Gorham on the Central Kansas uplift. This multipay area was tapped in 1926. The most recent Cambrian discovery is at Silver Creek in southern Nebraska's Cambridge arch country.

Other Cambrian areas include Ontario, Wyoming, Texas, Ohio, and New York. Many areas have reported good Cambrian shows, but the above areas are the only ones having commercial production.

THE CAMBRIAN-PRODUCING AREAS OF NORTH AMERICA

State, province, field	Year disc.	No. of wells	Producing depth	
KANSAS				
1. Albert	1935		3,600	Reagan
2. Buhr	1943		3,495	
3. Beaver	1934		3,335	
4. Bird	1940		3,500	
5. Carroll, N.	1954		3,450	
6. Clarence	1953		3,543	
7. Kraft-Prusa	1937		3,310	
8. Merten	1942		3,551	
9. Merten, SE	1949		3,567	
10. Merten, SW	1958		3,598	
11. Otis-Albert	1935		3,600	
12. Pleasant	1944		3,877	
13. Densmore	1957		3,542	
14. Norton	1953		3,681	
15. Ray, SE	1941		3,600	
16. Albert, W.	1946		3,614	
17. Otis	1934		3,527	
18. Fairport	1923		3,350	
19. Gorham	1926		3,299	
20. Mohl	1941		3,253	
21. Ellis, S.	1952		3,827	
TEXAS				
1. Dora, N.	1954	17	5,963	Cambrian: Wilberns
2. Dora, NW	1955	8	6,230	
3. EA	1954	(Hylton NW)	6,102	
4. Hylton, NW	1954	28	5,970	
5. White Flat	1952	*50	5,455	
6. Bronte				
7. Rawlings	1953	1	5,541	
8. Schick	1955	1	6,104	(Abd. 1957)
9. Wentz	1942	1	4,452	(Abd.—Texas' first; dwindled)
WYOMING				
1. Lost Soldier	1958	7	6,000	Cum. prod. = 6,171,025 bbl. (Deadwood)
2. Wertz	1948	1 (abd.)	7,535	Cum. prod. = 82,681 bbl.
NEBRASKA				
1. Sleepy Hollow	1960	57	3,534	(also dualed in Lansing-K. C. Penn. Reagan)
2. Silver Creek	1961	1	3,300	(4 Penn. wells)
NEW YORK				
1 well flowed Gatesburg gas in 1960.				
ONTARIO				
1. Princeton	1960	4 oil, 5 gas	2,900	Basal Quartz
OHIO				
1. Media County	1959	1	7,040	Trempelea

*Not all Cambrian.

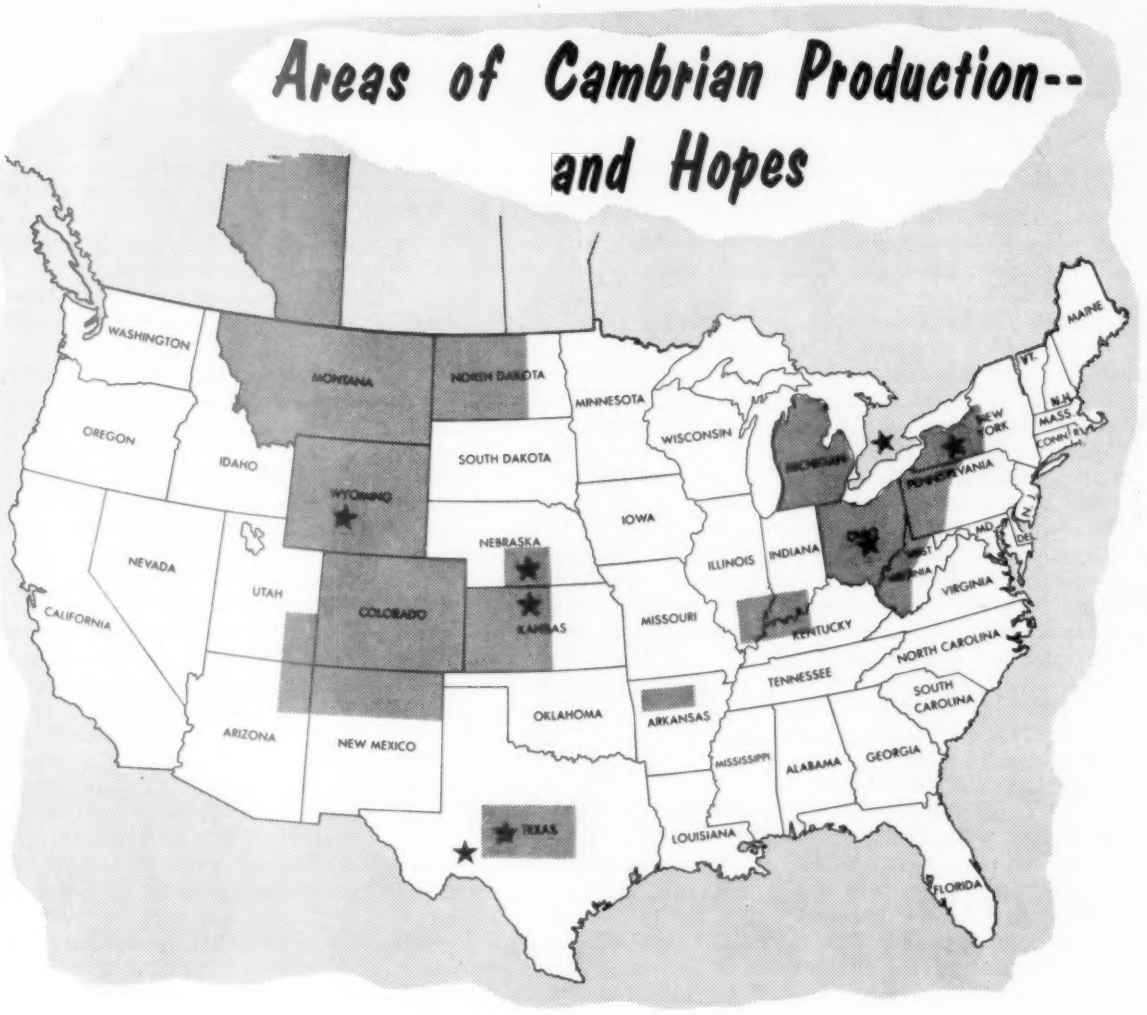
1. Ontario. Princeton field was opened in 1960 with production in the Cambrian basal quartz. The field now boasts four oil wells and five gas producers. Producing depth is 2,900 ft. This field discovery caused a leasing sensation throughout Ontario, promising an active drilling campaign into these geologically ancient rocks in the coming months.

2. Wyoming. There are two fields with Cambrian production in Wyoming—Lost Soldier with seven wells and Wertz with one well, now abandoned. Cumulative production from seven Cambrian wells at Lost Soldier is 6,171,025 bbl. Production at Wertz amounted to only 82,681 bbl. before the one producer was abandoned. Pay in the two fields is Deadwood Cambrian at 6,000 and 7,535 ft., respectively.

Wyoming was completely emergent at the end of Cambrian time. The early Cambrian sea was restricted to the Cordilleran trough to the west of Wyoming. This sea moved eastward to the state's western boundary early in Middle Cambrian Albertan time, continuing to move east throughout that epoch. Middle Cambrian rocks in Wyoming are represented by the Flathead sandstone below and the Gros Ventre shale above. The Flathead is a transgressive sandstone facies which becomes younger eastward. At the end of Middle Cambrian time the sea covered most of the west half of the state. This expansion continued until late Cambrian Croxian time, leaving all but the southeast corner of the state under water. Late Cambrian sediments grade from near-shore sandstones (Deadwood) to offshore limestones (Gallatin). The youngest Cambrian rocks were removed by pre-Ordovician erosion in the Wind River Mountains. In the Rawlins uplift area, erosion was so great that all of the Upper Cambrian rocks were removed completely, leaving only the Middle Cambrian.

3. Texas. Cambrian production

Areas of Cambrian Production-- and Hopes



W. Canada	Ontario Canada	Arizona	S.E. Utah	S.W. Colo.	San Juan basin	Arkansas	Colorado: Denver basin	Colorado: Anadarko, Raton	Illinois basin	Kansas	Michigan
Undiff.	**BASAL QUARTZ**	Tonto	Lynch	Ignacio	Ignacio	Eminence	Williams Canyon	Reagan	Trempealeau	Eminence	Trempealeau
			Bowman			Potosi			Franconia	Bonneterre	Franconia
			Hartman			Pre-Potosi	Fremont		Galesville	Lamotte	Dresbach
			Ophir				Harding		Eau Claire	**REAGAN**	Eau Claire
			Tintic				Manitou—Ute Pass, Sawatch		Mt. Simon		Mt. Simon

Montana	Nebraska	Nevada	N. M.	N. Y.	Dakotas	Ohio	Okla.	Penn.	N. Texas	W. Texas
Deadwood	Lamotte	Cambrian	Bliss (S.E., Delaware)	Little Falls	Dead-wood	**TREMPEA-LEAU**	Timbered Hills	Trempea-leau	Hickory	**WILBERNS**
	REAGAN		Wilberns (Midland basin)	Pottsdam		Franconia		Gatesburg		Riley
	Deadwood		Riley (Midland basin)	**GATES-BURG**		Dresbach	Honey Creek	Franconia—		**HICKORY**
			Ignacio (in west)			Eau Claire	Reagan	Galesburg		
						Mt. Simon		Eau Claire		
								Warrior		
								Mt. Simon		

West Va.	Wyoming: West	Bridger	Rawlins	Wind River	Laramie	Hanna	Denver	Big Horn	Powder River
Conococheague	Dry Creek	Gallatin	Buck	**GALLATIN**	Flathead	Flathead	Flathead	Gallatin	Gros Ventre, Flathead (West)
Elbrook	Dunoir	Gros	Spring	Gros Ventre				Gros Ventre	
Waynesboro	Park	Ventre	Flathead	Flathead				Flathead	
Tomstown	Death	Flathead							Deadwood (East)
Antietam	Canyon								
Harpers	Wolsey								
Weverton	Flathead								

first came to Texas in 1952 at White Flat field. This field gets Cambrian oil at 5,455 ft. Other fields began to appear in West-Central Texas in 1953, 1954, and 1955. North Dora, Dora Northwest, EA, Northwest Hylton, and Bronte all have Cambrian production.

Texas Cambrian rocks crop out in five areas—the Franklin Mountains, Hueco Mountains, the Van Horn area, the Marathon and Solitario uplifts, and the Llano uplift. Cambrian rocks go by different names in all of these areas. The Upper Cambrian on the Llano uplift is the best known—the Riley and Wilberns. Riley formation consists of the Hickory, Cap Mountain, and Lion Mountain members. The Wilberns has four members—the Wedge sand, the Morgan Creek glauconitic limestone or dolomite, the Point Peak shale, and the San Saba limestone.

Bliss sandstone is the Cambrian of the Franklin Mountains. It is 300 ft. thick. In the Van Horn region of Texas the sandstone of the same name is 700 ft. thick. Cambrian sandstone on the Marathon uplift called Dagger Flat. It is 500 ft. thick. Up to 125 ft. of sandstone and shale between the Ellenburger and Precambrian has been found in wells on the south end of the Central basin platform, 75 miles northeast of Dagger Flat outcrops.

4. Ohio. Cambrian production in the Buckeye State was long in showing up even though it had been found for many years in deeper wells. The state's deepest producer is a gas well in Medina County, discovered in 1959 with production at 7,040 ft. in the Trempealeau. This discovery set off a flurry of deep-drilling excitement throughout the state, lapping over into Pennsylvania and New York. Cambrian rocks are widespread in the eastern states. Several wildcats have found good oil and gas showings in the Trempealeau since the Medina County discovery, paving the way for more deep production in Ohio. Last year a wildcat in New York flowed gas from the Gatesburg, lighting the way for a new look at this widespread Appalachian formation.

5. Kansas. Kansas has the lion's share of Cambrian oil. There are 21 fields on the northern part of the Central Kansas uplift with production from Cambrian Reagan sandstone. Average depth of this Reagan production is about 3,500 ft. Reagan sand is widespread in the Mid-Continent, ranging from Nebraska southward to Oklahoma, and westward into southeastern Colorado and the Raton basin of northern New Mexico.

Although there is much discussion even yet over the age of prolific new production in southern Nebraska, most think that Sleepy Hollow field in Red Willow County has Cambrian Reagan production. Others think it is basal Pennsylvanian. Whatever the pay, the field is becoming one of the largest in the northern Mid-Continent. At last count there were 57 producers at Sleepy Hollow—some of them all-Pennsylvanian, some mixed Cambrian and Pennsylvanian.

Cambrian rocks have been drilled over a wide area of the Mid-Continent. Despite the widespread drilling to these zones, production still is limited to the Central Kansas uplift, the Cambridge arch, and the Permian basin in West Texas.

Recoveries per acre from Reagan in Kansas are 3,000 bbl. Over 50,000,000 bbl. of oil has been produced from Reagan sand, a small part of total Kansas production. Reagan oil comes from strat traps hugging the Central Kansas uplift. The sand is restricted to western Kansas, west of that uplift.

Cambrian sands in Texas are thought to be thief zones, getting their oil from rocks higher up the scale on the Eastern Platform. This is also true at Lost Soldier and Wertz in Wyoming.

More work needed. The years between 1926 and 1953 saw few Cambrian wells being drilled in the United States. Discoveries in Kansas and Texas after 1953 caused a pickup in basement drilling in the Mid-Continent. Cambrian oil so far has been associated with faulted reservoirs and truncated basement highs with Cambrian porosity overlapped unconformably by younger beds. Depth range of Cambrian oil runs from 3,100 ft. in Kansas to 3,900 ft., 5,400-6,100 ft. in Texas, and 5,400-7,500 ft. in Wyoming. These depths are indeed shallow in these days of ultradeep drilling. If the Nebraska Cambrian is finally decided upon, we will see more exacting exploration to these rocks. Even if the Nebraska Cambrian turns out to be Pennsylvanian, there will be a concerted search into the rocks just above basement on Cambridge arch and associated uplifts.

The search for Texas Cambrian oil has subsided, but there remains plenty of territory on the Eastern Platform that hasn't seen the pre-Ellenburger drill. A look at the accompanying table of Cambrian production will show the need for more wildcatting in known Cambrian areas. Our candidates for future Cambrian success are the Appalachians, Rocky Mountains, and upper and lower Mid-Continent. There may be lots more "basal Pennsylvanian" oil fields opened before the Cambrian finds its proper place on the oil column.

Louisiana field adds two new pays

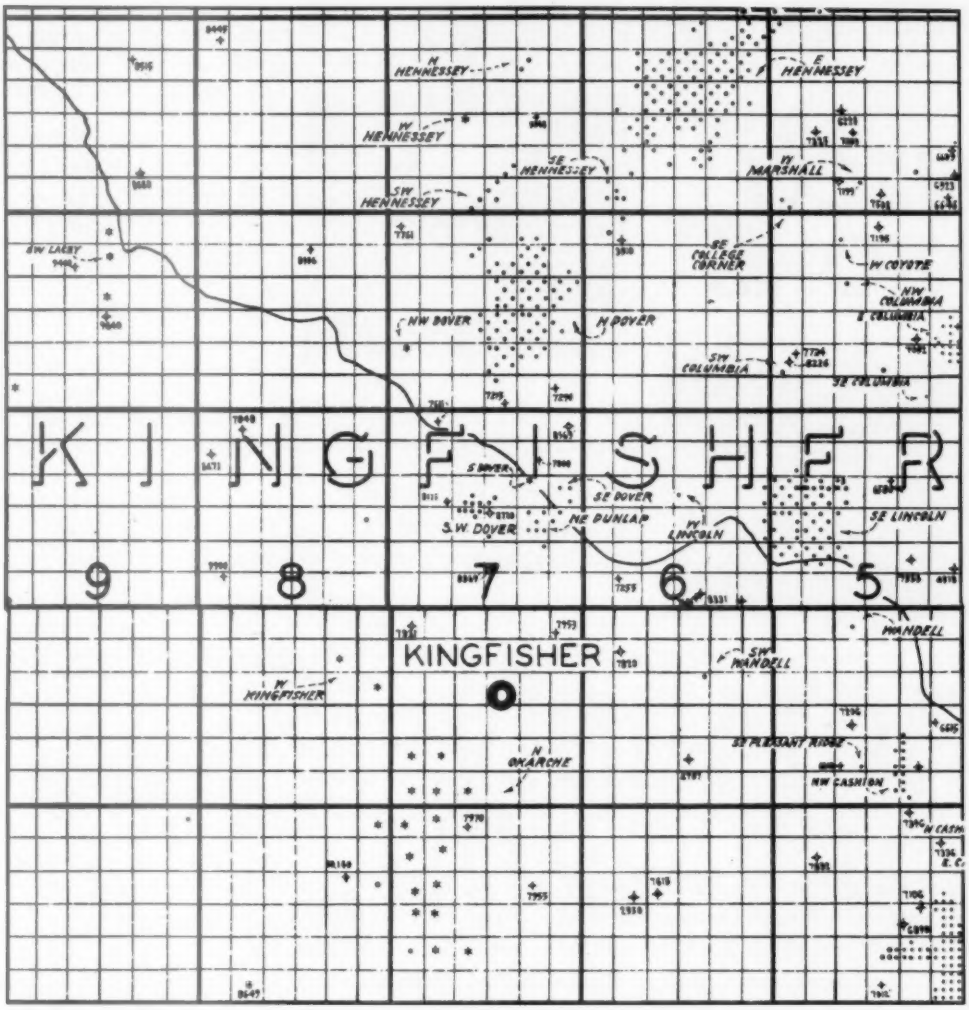
DISCOVERY of two new productive sands for the north flank of East Hackberry field, Cameron Parish, Louisiana, has been reported by Pan American Petroleum Corp.

Pan American's 54 Gulf Land "A" R/A "C" found 256 ft. of total pay in four zones. The well will be dually completed in the Camerina D and Camerina C zones, which are new to the area.

On 2-hour drill-stem test from perforations between 11,212-22 ft., the well flowed 182.88 bbl. of oil per day and 329 M.c.f.d. on 8/64-in. choke in the Camerina D sand. Gas-oil ratio was 1,797:1; b.s. and w., 0.20%; gravity 34.5°; and flowing tubing pressure, 1,850 psi.

In the Camerina C sand, the well was perforated between 11,032-38 and 11,060-70 ft. On 2-hour test it flowed 299.16 bbl. of oil per day and 335 M.c.f.d. on 8/64-in. choke. Gas-oil ratio was 1,120:1; b.s. and w., 0.20%; gravity, 33°; and flowing tubing pressure, 1,975 psi.

The well was drilled to 11,942 ft. and plugged back to 11,330 ft. It is located in 11-12s-10w, Cameron Parish.



HERE IS A SMALL SECTION of a large new state pool map of Oklahoma. Shown here is Kingfisher County, currently the busiest single drilling area in the nation. More than 80 active locations mark this prolific new Mid-Continent oil bonanza.

New Sooner oil, gas map available

A COMPLETE and helpful oil and gas map of Oklahoma is now available from Oklahoma Oil Maps, 204 Third and Broadway Building, Oklahoma City. This map, a state pool map, showing all wells drilled, is up to date. Scale of the section, township, and range map is 1=6. Pools are named and each individual well shown.

Two Kingfisher County fields are linked up

Two producing areas opened earlier in the year in Oklahoma's Kingfisher County boom have been linked. The well is Champlin Oil & Refining Co. 1 Vadder, C NE SW 9-18n-5w.

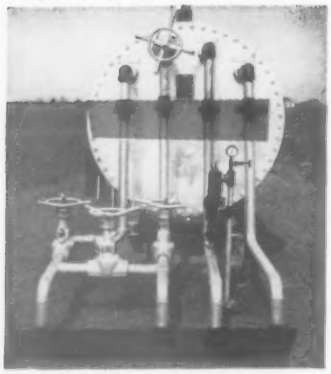
The well flowed 129 bbl. of new oil in 4 hours through ½-in. opening from Meramec open hole at 6,389-6,484 ft. This links Northwest Columbia pool to the south and West Coyote field to the northwest. West Coyote field was opened in March at 1 Sturgeon in SW SW 4-18n-5w. It flowed 10 bbl. per day from Meramec on time intermitter through open hole at 6,327-6,420 ft. The 1 O'Hern, NE NW 16-18n-5w, opener of Northwest Columbia, was completed by Champlin and Harper for 62 bbl. of oil in 3½ hours from Meramec open hole. This was first completed by Harper. Champlin then took over and completed the well for 40 bbl. of oil in 2¼ hours from Oswego.

Oklahoma's Woodward County adds new gas discovery

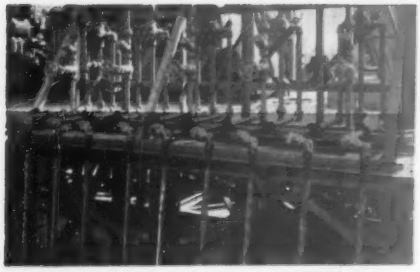
New gas production is reported in northwestern Oklahoma at a Woodward County wildcat. The new strike is Hefner Production Co. 1 Morehart, C NW SE 31-23n-22w, 3½ miles west of Tangier.

A drill-stem test at 8,315-8,405 ft. flowed 2,310 M.c.f.d., after 15 minutes, increasing to 4,093 M.c.f.d. after 30 minutes. Pay is Morrow.

WECO UNIONS



Heater Hook-up with WECO Unions



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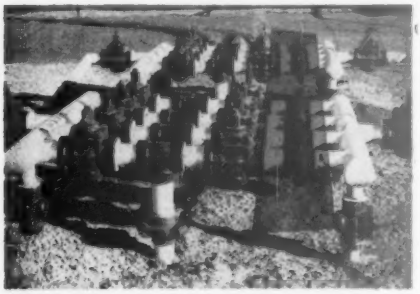

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Caddo County. Sinclair Oil & Gas Co. have flowing oil production in Viola Ordovician lime at 6-A Lewis, NW NE SW 2-5n-12w, Apache field.

A drill-stem test at 2,524-74 ft. got 92 bbl. of oil in 1 hour through 5/8-in. choke.

Pennsylvania drillers digging deep

HERE'S what has taken place in Pennsylvania during the last 2 months in deep drilling.

In Bedford County, a development well was completed in Purcell field at an open-flow of 455 M.c.f.d. and a rock pressure of 1,865 psi. in 11 days.

The second well to be completed in Blair County by Phillips Petroleum Co. was abandoned after drilling and fracturing the Oriskany sandstone. The open-flow rate was 25 M.c.f.d. The first well, the discovery well, had an open flow of 1,300 M.c.f.d. A third location in this area will soon be made by the same company.

Clearfield County had two dry holes and three gas producers during the past 2 months. In Helvetia pool two development wells extended the pool to the northeast while a third one, 1½ miles further northeast, was too far downstructure and was plugged and abandoned.

A fourth development well, the T. W. Chapman by New York State Natural Gas Co., had an open flow of 5,876 M.c.f.d. of gas. Both of the gas wells encountered some salt water in the producing horizon, Onondaga chert - Oriskany sandstone. A Rockton pool outpost found too much water in the Oriskany and was abandoned.

A development well in Lexington pool in Erie County was plugged and abandoned after finding the Medina section dry.

Ohiopyle field in Fayette County had its fourth development gas well when the 1 Morrison by Snee & Eberly and Peoples Natural Gas Co. produced 4 M.M.c.f.d. of gas. This field is on the Laurel Hill anticline.

In Lycoming County on the Slate Run anticline, Felmont Oil Co.'s F-132 wildcat was abandoned at a TD of 6,865 ft. after finding the Oriskany sandstone dry.

An outpost in Williams pool,

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Somerset County, was abandoned after finding a show of gas in the Oriskany sandstone at 8,468 ft.

Peoples Natural Gas Co. 1 B. G. Clark, a wildcat on the Laurel Hill anticline east of Blair pool, discovered the Clark pool, a new pool in Seven Springs field. The Clark well is located about 2 miles from the Blair pool and separated from this pool by numerous faults. The final open flow after fracture was 6,500 M.c.f.d. at a rock pressure of 3,309 psi. in 96 hours. Gas was obtained in the Onondaga chert at 8,370 ft. The well was completed before reaching the Oriskany.

The Paul Benedum wildcat in Warren County on Wt. 5206 in Limestone Township, found 860 M.c.f.d. of gas in the Medina section at a rock pressure of 960 psi. in 3 hours. This well has shown the possibilities of production from the Medina in a large area from the Ohio line east of central Warren County. The well is still being tested.

Three interesting wildcats are being drilled on the Laurel Hill anticline. One in Clearfield County by New York State Natural Gas Co., one in Clinton County by Felmont Oil Corp., and the third one in Lycoming County, by Felmont Oil Corp.

A rank wildcat has just been announced by Atlas Drilling Co., and Sun Oil Co., in Cussewago Township, Crawford County.

A wildcat 4 miles southwest of Indian Spring pool in Crawford County, a farmout of Benedum Trees Oil Co., the 1 Brooky found 2,600 M.c.f.d. in the Red Medina. This makes the area between this well and the Indian Springs pool good hunting.

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REGIONAL MAP shows location of Conley multipay field at the easternmost end of Palo Duro basin in northwestern North Texas.

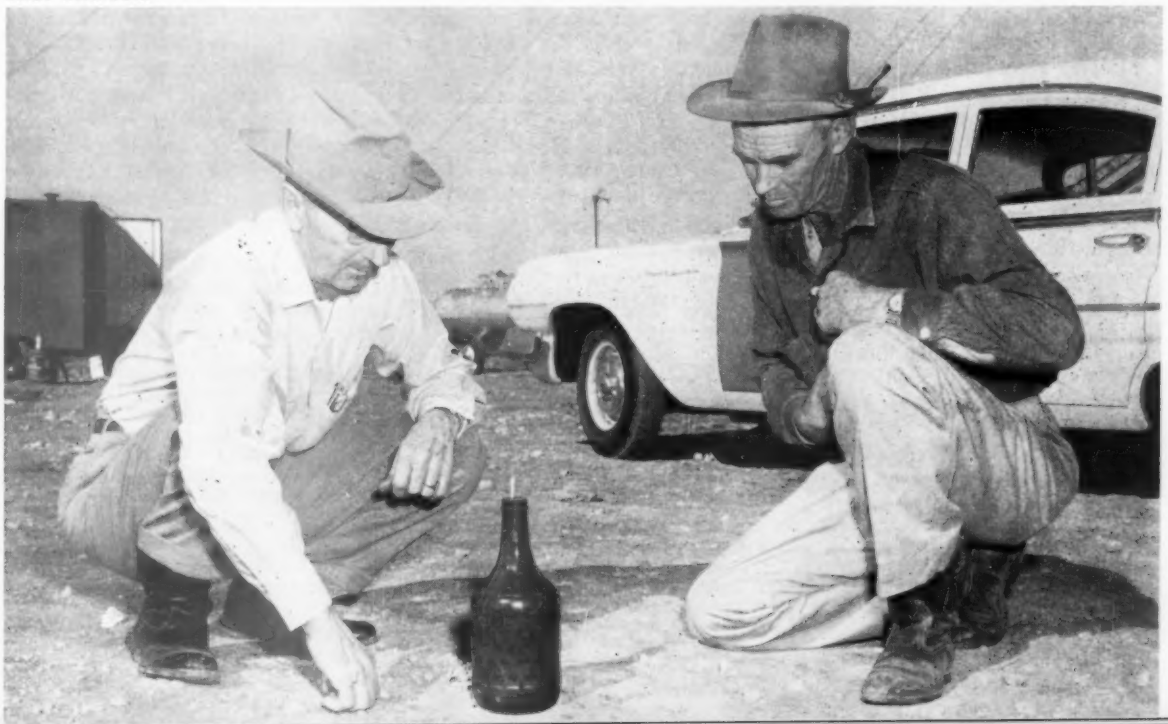
RIG DRILLING Shell 1-A Conley in Conley field. Medicine Mount, legendary burial ground of the plains Indians, appears on the horizon.

Conley promises action in Texas

CONLEY multipay field at the eastern end of Texas' Palo Duro basin is the most promising oil find yet in this sparsely productive region. Until 1959 only 1 small producer and 40 dry wildcats made up the drilling score in Hardeman County at the extreme southeast corner of the Texas Panhandle. In March of that year Shell Oil Co. officially opened Conley field with production from Mississippian at 7,800-8,008 ft. at the 1 Conley, signaling an intensive drilling program in what well may be the best oil discovery for this part of Texas in many years.

Slow start. Oil was long in coming to Hardeman County as well as to Palo Duro. Shell opened oil production in the western end of the basin a few years ago in Oldham County. That Vega area discovery at Alamosa Ranch caused quite a stir, but the flurry died. Now Shell has opened the east end of the long oil-dry Palo Duro. Conley doesn't appear to be just "another" oil field.

GRAVITY of new oil is checked by **Production Foreman Glenn Shreeves and Lease Operator H. O. Smith.** Oil is from 1 Wilson, recently completed producer. **Conley field produces from four pays.** Nearest production is at Fargo field, 19 miles northeast.



CLUE TO OIL. D. D. Bowling, division production geologist, standing at left; J. L. Mahaffey, exploitation engineer, standing at right; and R. L. Swanson, seated, look over core samples from wells drilled in Hardeman County, where Shell Oil Co. discovered Conley field.

ABILENE Division Production Superintendent Earl Buck and Glenn Shreeves look over a flow meter chart that registered production from 1 Wilson during completion tests. Completion rig at 1 Wilson is shown in immediate background—drilling rig at far left is on location at 1-B Conley.

There wasn't much interest in this section of the basin until 1954 when Shell joined the hunt with a reconnaissance seismic survey. This survey uncovered enough valuable information to spark the company into drilling the Conley discovery. An 8,000-ft. dry hole drilled in the immediate area in 1939 furnished much worthwhile data—data thought unworthy by those who drilled before. Acreage was bought and Shell spudded in in December 1958.

Initial potential of the discovery well was 226 bbl. daily, but this fell off rapidly, turning the discovery into a disappointing pumper. The 1 Malear, a confirmation try, was drilled ½ mile east. It became a duster in November 1959. Meanwhile, Shell didn't give up on the Conley well. Fracturing brought the well up to near its initial production level. Then Shell reworked and fractured the old 1939 hole. This well, 2 Conley, came in flowing 195 bbl. per day on 18/64-in. choke. Production was from Meramec Mississippian. After this June 1960 success, the 3 Conley was drilled.

New pays. The 3 Conley, Shell's fourth well on the lease and third producer for the field, resulted in a new producing sand for Conley. Potential was 182 bbl. daily from Palo Pinto Pennsylvanian and 550 bbl. per day from Chappel Mississippian. The 4 Conley was next, flowing 300 bbl. daily from Palo Pinto and 236 bbl. from Chappel. The 5 Conley was dry in the Palo Pinto, but did flow 196 bbl. per day from Ellenburger Cambro-Ordovician, opening another new pay. The 5 Conley also flowed 160 bbl. daily from Chappel.

Other new wells include the 1 Wilson, an Osage Mississippian producer at 108 bbl. per day and 166 bbl. from Chappel. The 1 Flynn was completed last winter flowing 240 bbl. daily from Chappel and 235 bbl. from Ellenburger. Total score this year in the field is four producers. Wells now drilling in the field are: Phillips Petroleum Co. 2 Conley "A," Pure Oil Co. 1 N. Cullar, Shell 1 C. G. Conley "A," 1 C. G. Conley "B," 1 W. H. Flynn "A," 1 W. A. Melear, OWWO.

Phillips recently completed 1 Conley "A" 6 miles southeast of Quanah in NW¼ Section 82, Block H, W&NW Survey, A-894, flowing from three pays—Osage, Palo Pinto, and Mississippian. This first triple producer for the field flowed 151 bbl. per day from Osage through 20/64-in. choke from 8,118-23 and 8,126-32 ft., 130 bbl. daily from Palo Pinto through 10/64-in. choke at 5,235-65 ft., and 144 bbl. daily on 16/64-in. choke from Mississippian at 8,004-6, 8,008-12, 8,015-29, 8,032-42, and 8,057-8,100 ft. Pipeline connection is with Scurlock Oil Co.

A big find. The results at Conley field promise this to be one of the best oil finds in northwestern Texas in a long time. It is certainly the best field yet tapped in Palo Duro. Four pay zones, good potentials, and intermediate producing depths make this an attractive prospect. Conley's success will cause many to take another look at their eastern Palo Duro maps.

Photos courtesy The Wrangler, Shell Oil Co., Midland. Information from Shell Oil Co. and The Oil and Gas Journal.

Discovery wells

OHIO

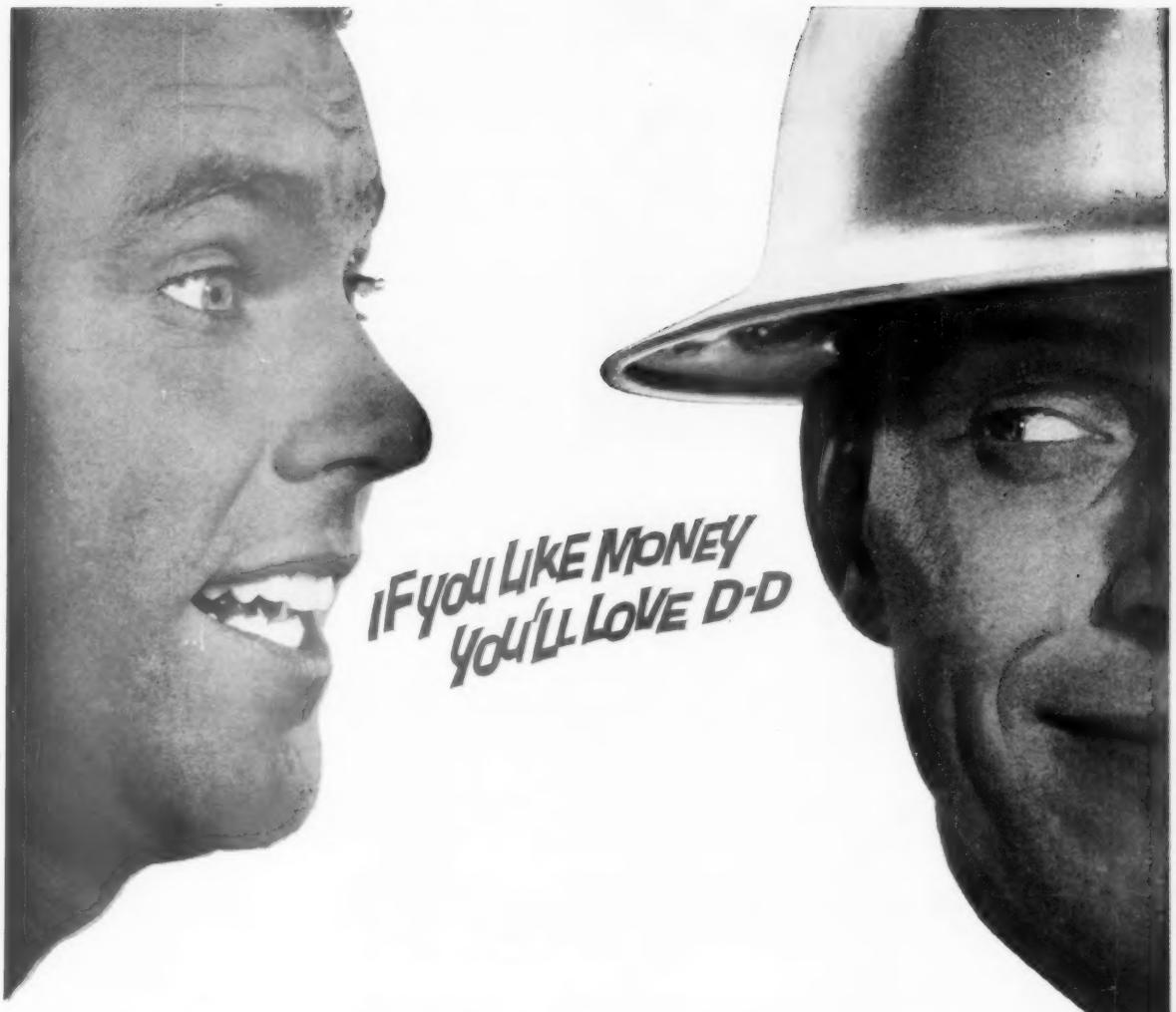
Lawrence County:
Harvey Starr 1 M. N. Taylor, Sec. 7, Mason Twp. IPF 2,090 M.c.f.d., IRP 1,032 psi., Clinton 3,384-3,400 ft. TD 3,410 ft. New gas discovery.

TEXAS PANHANDLE

Lipscomb County:
Amarillo Oil Co. 1 M. B. Broyles, 5 miles southwest of Follett in Sec. 978, Blk. 43, H&TC Sur., IPAOF 7 M.M.c.f.d., GOR 104,000:1, SIP 2,580 psi., Cleveland sand 7,359-71 ft. TD 9,730 ft. New gas-condensate discovery.

OKLAHOMA

Ellis County:
Pan American Petroleum Co. 1 Purdum, C NE SW 3-22n-25w, 5 miles north of Linscott pool. IPF 2,930 M.c.f. in 16 hours, ½-in. choke, FTP 500, FCP 820; SITP 1,925 psi., SICP 1,950 psi. Morrow 8,668-70 ft. TD 9,200. PBTD 8,913 ft. New gas discovery.



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March completion hit first-quarter high at 4,048

State—	All wells: Total wells	Oil	Cond.	Gas	Dry	Service	Footage	Cum. wells 1961	Cum. footage 1961	Cable-tool comp.	D.D	Wildcats: Total	Oil	Cond.	Gas	Dry	Footage	Cum. wells 1961	Cum. footage 1961
Alabama	5	4	0	0	1	0	64,854	17	202,425	0	0	1	0	0	0	1	18,741	3	41,556
Alaska	4	4	0	0	0	0	43,807	8	84,182	0	0	0	0	0	0	0	0	1	12,135
Arizona	1	0	0	0	1	0	6,749	4	10,415	0	0	1	0	0	0	1	6,749	3	9,145
Arkansas	57	28	0	2	26	1	193,711	139	514,983	0	0	5	0	0	0	5	20,572	27	108,570
California	154	98	0	17	37	2	774,619	433	1,919,414	0	13	29	1	0	5	23	184,262	67	403,144
Colorado	58	8	0	11	39	0	280,059	161	772,770	0	4	30	0	0	5	25	134,755	90	422,288
Florida	3	0	0	0	3	0	22,970	7	68,620	0	0	3	0	0	0	3	22,970	7	68,620
Georgia	0	0	0	0	0	0	0	1	4,500	0	0	0	0	0	0	0	0	1	4,500
Illinois	131	35	0	1	33	62	253,598	466	918,237	19	7	24	3	0	1	20	47,299	91	153,164
Indiana	40	15	0	1	24	0	49,597	156	218,000	23	0	12	1	0	1	10	15,561	36	38,734
Kansas	504	269	1	23	136	75	1,069,336	1,359	3,190,463	259	18	94	10	0	7	77	355,604	257	1,001,377
Kentucky	171	58	0	23	86	4	229,097	352	507,196	71	4	22	3	0	2	17	24,167	40	50,008
Louisiana	343	151	0	56	134	2	2,899,132	898	7,117,333	0	0	64	4	0	6	54	583,288	138	1,289,038
North	106	39	0	21	45	1	382,467	316	1,103,562	0	0	25	3	0	0	22	106,571	54	275,347
South	198	90	0	33	75	0	2,118,764	468	4,808,499	0	0	35	1	0	6	28	427,977	77	928,798
Offshore	39	22	0	2	14	1	397,901	114	1,205,272	0	0	4	0	0	0	4	48,740	7	84,893
Michigan	44	19	0	1	24	0	151,827	170	550,216	14	0	14	1	0	0	13	45,547	69	207,930
Mississippi	38	15	1	2	20	0	414,248	137	1,395,006	0	0	12	0	0	0	12	126,913	49	498,182
Missouri	5	0	0	0	5	0	10,618	14	28,217	0	0	5	0	0	0	5	10,618	13	26,823
Montana	39	20	0	0	19	0	246,223	104	565,409	0	1	15	2	0	0	13	110,566	46	280,059
Nebraska	85	49	0	0	36	0	376,285	191	879,520	0	0	31	3	0	0	28	149,850	81	389,929
Nevada	1	1	0	0	0	0	7,755	8	17,350	0	0	0	0	0	0	0	0	7	9,595
New Mexico	167	83	0	29	54	1	890,660	436	2,267,738	0	1	40	5	0	1	34	207,718	84	443,037
West	50	17	0	24	9	0	255,326	162	835,976	0	0	7	0	0	0	7	10,744	21	57,170
East	117	66	0	5	45	1	635,334	274	1,431,762	0	1	33	5	0	1	27	196,974	63	385,867
New York	36	15	0	5	5	11	63,249	96	148,156	36	0	5	0	0	2	3	18,476	7	24,066
North Dakota	20	9	0	0	11	0	122,895	54	334,674	0	0	7	1	0	0	6	52,954	13	107,955
Ohio	92	43	0	21	19	9	213,001	263	651,885	90	1	4	0	0	2	2	12,683	11	35,784
Oklahoma	612	274	1	65	182	90	1,998,201	1,519	4,968,193	151	14	49	9	0	3	37	241,956	157	810,869
Oregon	0	0	0	0	0	0	0	1	9,579	0	0	0	0	0	0	0	0	1	9,579
Pennsylvania	50	18	0	17	6	9	149,017	160	511,363	40	0	0	0	0	0	0	0	9	64,343
South Dakota	0	0	0	0	0	0	0	2	8,924	0	0	0	0	0	0	0	0	2	8,924
Tennessee	0	0	0	0	0	0	0	12	4,598	0	0	0	0	0	0	0	0	12	4,598
Texas	1,176	607	59	71	426	13	5,239,087	3,447	15,521,989	17	11	253	18	8	7	220	1,168,368	725	3,593,886
District 1	68	25	1	2	39	1	223,718	199	612,366	2	1	32	0	1	1	30	149,283	79	344,360
District 2	51	22	9	8	12	0	375,159	166	1,191,200	0	2	7	0	0	3	4	47,400	33	235,342
District 3	85	35	10	6	34	0	580,686	259	1,859,426	0	0	11	0	2	1	8	103,439	57	528,741
District 4	107	46	10	6	45	0	576,302	316	1,805,036	0	1	18	0	1	0	17	93,538	67	362,819
East	97	53	9	0	35	0	508,683	272	1,370,089	0	0	24	1	1	0	22	122,647	64	309,635
District 7-B	161	76	0	6	79	0	511,063	477	1,470,350	0	0	57	8	0	2	47	187,315	142	513,030
West	302	201	7	4	87	3	1,455,490	863	4,371,049	15	3	69	5	0	0	64	312,488	182	899,101
District 9	196	97	10	2	78	9	493,458	575	1,436,520	0	4	27	3	1	0	23	92,012	76	232,606
District 10	109	52	3	37	17	0	514,528	320	1,405,953	0	0	8	1	2	0	5	60,246	25	168,252
Utah	28	16	0	2	10	0	158,074	62	350,595	0	1	9	0	0	1	8	49,834	29	164,080
Washington	1	0	0	0	1	0	4,482	3	11,051	0	0	1	0	0	0	1	4,482	3	11,051
West Virginia	81	5	0	64	11	1	210,041	249	619,520	81	0	2	0	0	0	2	14,737	2	14,737
Wisconsin	0	0	0	0	0	0	0	6	8,100	0	0	0	0	0	0	0	0	6	8,100
Wyoming	102	43	1	5	52	1	530,312	268	1,357,402	0	3	35	0	0	1	34	201,897	105	550,238
Total March 1961	**4,048**	**1,887**	**63**	**416**	**1,401**	**281**	**16,673,504**	**11,203**	**45,738,023**	**801**	**78**	**767**	**61**	**8**	**44**	**654**	**3,830,567**	**2,192**	**10,866,044**
Total February 1961	3,159	1,476	36	311	1,095	241	12,045,313	.....	.....	627	79	568	53	4	32	479	2,859,382	.....	.....
Cumulative 1961	**11,203**	**5,108**	**234**	**1,116**	**4,008**	**737**	**45,738,023**	.....	.....	**2,215**	**216**	**2,192**	**183**	**27**	**106**	**1,876**	**10,866,044**	.....	.....
Cumulative 1960	10,791	5,041	350	903	4,173	324	47,105,567	.....	.....	.....	.....	2,381	215	22	70	2,074	10,885,345	.....	.....

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Max R. Lents . . . natural gas consultant.

Lents to Preach Processing

- New president of NGAA wants regulatory agencies to know the score on the natural-gas processing industry.

PROMOTING a better understanding among regulatory bodies in regard to the problems and economics of natural-gas processing is one of the major goals of Max R. Lents, new president of the Natural Gasoline Association of America.

He wants especially to bear down on the importance of liquefied-petroleum gas and liquefied-refinery gas.

Besides pointing out that expansion of gas-transmission facilities has been a prime factor in natural-gas production in recent years, Lents emphasizes another statistic: LPG from casinghead gas in prorated fields and LRG from refineries processing prorated crude still represent more than half of the natural-gas liquids being recovered in the U. S.

A wide experience in testifying before regulatory commissions should serve Lents well in attaining his goal.

Lents has been active in the NGAA for many years. In his early days with the association, he served on the technical and absorption committees. He was first elected to the board in 1948 and has served two 2-year terms as vice president.

Background . . . A native of Chickasha, Okla., Lents earned a BS in 1936 from the University of Oklahoma. He majored in the refining and natural-gasoline division of petroleum engineering.

After working for a short time as a roustabout for Halliburton and Gulf in the Seminole field, he joined Shell's refining department at Deer Park, Tex., where he became technical assistant in the topping department.

In 1941, he left Shell to take a job as chief process engineer with the Cotton Valley Operators Committee near Haynesville, La. There he helped to design, construct, and operate the major recycling plant which made Cotton Valley a textbook case in those early days of unitization, gas cycling, and pressure maintenance.

During his 5 years with this organization, Lents rose to assistant general manager. He also held a post on the Haynesville Operators Committee.

In 1946, Lents joined the Old Ocean Oil Co. He became assistant general manager and later rose to vice president and general manager. He resigned in 1949 to join the consulting firm of Butler, Miller, and Lents in Houston.

Since then Lents has taken an active part in the establishment of a number of companies dealing in natural-gas processing. He was instrumental in the design of such plants in Snyder, SACROC, and Salt Creek, Tex.

As a consultant, he has visited almost every producing state in the country.

▶▶▶ Personals

Three coordinators have been named in Humble's new natural-gas division organization. They are **W. D. Moore,** coordinator of economics and planning; **W. E. Curry, Jr.,** negotiating and marketing coordinator; and **J. R. Suman, Jr.,** supply and Federal Power Commission coordinator. **W. J. Greenwald,** general manager of the division, and **John J. Carter,** manager, were named to their posts a few months ago.

R. P. Alves, merchandising supervisor in Dallas for American Petrofina, has been named Tulsa district manager.

Thomas F. Popp, district engineer for Sunset International Petroleum Corp. in Denver, has been promoted to division engineer in Beverly Hills, Calif.

Charles W. Walker, assistant superintendent for Phillips Petroleum's Odessa, Tex., district engineering department, has been promoted to district superintendent, engineering department.

Dr. Paul M. Pitts has been named assistant to the general manager of Atlantic Refining Co.'s research and development department. **John C. Martin** has been named manager of the general services division, research and development.

Personals

George C. Hardin, Jr., general manager of the Michel T. Halbouty oil and gas interests in Houston, and executive vice president of Halbouty Alaska Oil Co., has resigned to enter consulting work with his brother, **Frank R. Hardin**, in Houston. George Hardin was with U. S. Geological Survey before joining Halbouty 15 years ago. He will continue as a director of Halasko. Frank Hardin has been a Houston consultant for 2 years. Prior to that he was district geologist for Austral Oil Co. in Lafayette, La.

G. HARDIN

Max M. Ellis has been promoted to senior research chemist at Union Oil Co.'s Brea, Calif., research center. **Carl Erik Hedborg** has been promoted to senior research engineer, Brea.

David L. Florence, vice president of Mayflo Oil Co., and **Lester T. Potter,** president of Lone Star Gas Co. and Lone Star Producing Co., have been elected directors of Republic National Bank of Dallas. **J. C. Karcher,** president of Concho Petroleum Co., has been named associate director of the bank.

John R. Lavens, Jr., president of Oilfield Research, Inc., Evansville, Ind., has been elected president of Independent Oil Producers and Land Owners Association, Tri-State. Other new officers include **J. D. Turner,** Evansville independent, secretary; and **Victor R. Gallagher,** Victor Drilling Co., Evansville, treasurer. Executive committee members are **James Buthod,** Evansville attorney; **T. M. Egan,** Evansville independent; **Frank Zogg,** Zogg Oil Co., Owensboro, Ky.; **George A. Hoffman,** Henderson, Ky., independent; **W. G. Harris,** Farrar Drilling Co., Mount Vernon, Ill.; and **Ira Van Tuyl,** V. T. Drilling Co., Evansville. Directors include **Charles Rafferty,** T. W. George, Mount Carmel, Ill.; **Walter Keahey,** Victor Drilling, Evansville; **R. W. Kuzmich,** RK Petroleum Corp., Mount Carmel; **Stanley Lambert,** Owensboro independent; and **Guy McGaughey, Jr.,** Mount Carmel attorney. **Elmer L. Hoehn,** Jefferson, Ind., is executive secretary of the association.

Graham B. Moody, Berkeley, Calif., consultant, has been elected a director of Buttes Gas & Oil Co., Oakland, Calif. Moody is a past president of American Association of Petroleum Geologists and was chief reserves engineer for Standard Oil Co. of California before becoming a consultant.

Guy L. Honeycutt, assistant manager at American Oil Co.'s Texas City refinery, has been given a temporary assignment with Amoco International to assist with operations in Italy. Standard Oil Co. (Ind.), the parent company, recently bought a refinery at Cremona, Italy, and a chain of 700 service stations in northern and Central Italy (OGJ, April 17, p. 88).

Jack N. Conley, Rocky Mountain area geologist for Kilroy Co. of Texas, has been elected vice president, geological department. He will move to the company's Houston headquarters office from Denver. **Reid M. Waltman** will succeed Conley as area geologist in charge of Rocky Mountain operations. **Achille N. Vitali, Jr.,** formerly with Caulkins Oil Co. in Rock Springs, Wyo., has joined Kilroy in Denver as geologist.

J. L. Coulson, assistant district production manager for Gulf Oil in Midland, Tex., has been named production manager for the New Orleans production district. He succeeds **W. B. Hopkins,** who has been transferred to Pittsburgh. **E. E. Merkt, Jr.,** Midland production district manager, has been transferred to Mene Grande Oil Co. in Venezuela. **H. B. Leeton,** production manager in Midland, will succeed Merkt there. **E. W. Brake,** district production manager in Denver, will succeed Leeton in Midland. **C. D. Borland, Jr.,** area production manager in Sand Hills, Tex., will replace Brake. Borland will be succeeded by **W. L. Merrill,** assistant production manager in Oklahoma City.

C. T. Jones, Tulsa consultant, has joined North American Royalties, Bismarck, N. D., as exploration manager.

Herman W. Weddle, northern division development geologist for Standard Oil Co. of California in Bakersfield, Calif., has retired after 33 years with the company.

Michael D. Reddin, assistant to the chief development engineer for Richfield Oil Corp.'s Canadian operations, has been promoted to chief development engineer. He succeeds **Robert R. Ritter,** who has been transferred to Alaska.

T. Graeme McLintock, executive vice president of BP Canada, Ltd., has been appointed deputy general manager of British Petroleum's marketing department with headquarters in London. **R. N. Tottenham-Smith,** chief BP representative in Paris with Soc. Francaise des Petroles BP, an affiliate, will succeed McLintock with the Canadian company.

WAER

McHENRY

Roy Waer and **Paul McHenry** have been elected vice presidents of Macmillan Petroleum Corp. Waer, California division manager since 1958, will continue to be in charge of California operations. McHenry will continue as manager of the Arkansas division.

John R. Gisburne, manager of the geological department in Skelly Oil Co.'s Canadian division, has been named division manager of exploration and head of the Calgary office. Land and lease and geological departments in the Canadian division have been consolidated. **John J. English** has been promoted to district geologist and **John Kozak** has been promoted to district land man. **Jake Torbert,** land manager in Calgary, has been transferred to Tulsa headquarters as division land man.

I. H. Ricketts, project engineer with Williams Brothers Co. in Tulsa, has joined Calnev Pipe Line Co. as general superintendent. He will headquarter in San Bernardino, Calif. Ricketts was with Continental Pipe Line Co., Platte Pipe Line Co., and Cities Service before joining Williams Brothers. The Calnev products system, now under construction, is expected to begin operations May 1. The line will link refineries in the Los Angeles basin area to Las Vegas, Nev.

RICKETTS

P. H. Hunter, president of Interstate Oil Pipe Line Co., has been elected president of West Shore Pipe Line Co., new company which plans to build a Chicago - to - Milwaukee products line. Other officers include **W. F. Schoenthaler,** Shell, and **Fred F. Steingraber,** Pure, vice presidents; **A. C. Hutcheson,** Pure, secretary; and **R. F. Sturgis, Jr.,** Pure, treasurer. Directors are **C. H. Albitz,** Texaco; **R. L. Grogan,** Clark Oil & Refining Co.; **S. L. Jackson,** Standard Oil Co. (Ind.); **W. L. Kygar,** Continental Pipe Line Co.; **Ben D. Leuty,** Cities Service Pipe Line Co.; **L. H. True,** Magnolia Pipe Line Co.; **Jack H. Rice,** Marathon Pipe Line Co.; Hunter; Schoenthaler; and Steingraber.

O. M. Turner, superintendent of Sohio Pipe Line Co.'s products pipeline division in Fostoria, Ohio, has been named general superintendent of gathering operations and director of pipeline activities in the tri-state and southwestern regions. **A. D. Dorris,** tri-state division superintendent, has been transferred from Grayville, Ill., to Cleveland as superintendent, administration.

George Hessong, chief engineer at United Gas Pipe Line Co.'s Rodessa compressor station in the Shreveport, La., district, has been named chief engineer of the Tallulah, La., compressor station, Monroe district. **R. A. White** has been promoted from first engineer to chief engineer at the Iowa compressor station in the Lafayette, La., district. **J. O. Munnerlyn,** first engineer in the Edna, Tex., compressor station, has succeeded Hessong at Rodessa. **Clyde G. Martin** will succeed Munnerlyn in Edna.

W. D. Walser, vice president of Tennessee Gas Transmission Co., has been elected senior vice president. Four men have been elected TGT vice presidents. They are **James E. Ivins,** corporate secretary and senior attorney; **Walter Fawcett,** director of gas contracts; **Leonard F. Lee,** manager of the Washington, D. C., office; and **Gilbert Fitzgerald,** assistant controller. **H. F. Aby** has been named corporate secretary and general attorney. Ivins will continue as senior attorney.

A. S. Munneke, district superintendent for Service Pipe Line Co. on special assignment in Tulsa, has been named electrical and communications supervisor. He succeeds **John Holder,** who recently retired.

Charles L. Lockett, associate regional coordinator, Middle East, for Standard Oil Co. (N. J.), has retired. Lockett is a former general manager of Middle East Pipeline, Ltd., and former president of Esso Standard (Near East).

Carl J. Greek, manager of the Youngstown, Ohio, sales division of Standard Oil Co. (Ohio), has been named Columbus, Ohio, division manager. He succeeds **John P. Sharkey,** who has retired after 41 years with the company. **Wilfred Gaidry,** Cleveland marketing staff retail sales manager, will succeed Greek in Youngstown.

Theo N. Law, president and founder of Falcon Seaboard Drilling Co., Tulsa, has been elected chairman, a new position. He will continue as chief executive officer. **C. W. Alcorn,** executive vice president in charge of Gulf Coast operations, has been elected vice chairman and **J. L. Stauss,** executive vice president in the company's Tulsa general office, has been elected president. Law and Alcorn will headquarter in Houston, Stauss will headquarter in Tulsa. **J. O. Brown** and **T. N. Law, Jr.,** Tulsa, vice presidents, have been elected directors.

▶▶▶ Personals

John J. Cullen, general superintendent of California Oil Co.'s Perth Amboy, N. J., refinery, has been named manager of operations in Caloil's refining department. He succeeds **E. J. Karle,** recently named vice president of the eastern division. **Robert W. Keck,** general operating foreman in the utilities section at Perth Amboy, has been named senior refinery planner there.

CULLEN

Robert J. Minton has resigned as president of English Oil Co. to become an independent producer and geologist in Salt Lake City.

Grover E. Ledlie, Jr., exploration manager for Falcon Seaboard Drilling Co., has resigned to open consulting offices in Tulsa.

Robert C. Erickson has been transferred by Standard Oil Co. of California from Ventura, Calif., to Bakersfield, Calif., where he will be division development geologist.

Carl Jonswold, general manager of wholesale marketing for Pure Oil, has been named manager of the new retail fuel-oil sales department.

P. L. Richards, assistant general manager of Esso Export Corp.'s cargo - sales department, has been named general manager of a new chemical division in the marketing-coordination department of Standard Oil Co. (N. J.), the parent company.

L. S. Burke, assistant superintendent of Continental Oil Co.'s Ponca City, Okla., refinery, has been named operations superintendent of the new Panama refinery being built by Refineria Panama, SA, Conoco affiliate. **Dwight E. Huth,** superintendent of the catalytic cracking division in Ponca City, will succeed Burke as assistant superintendent in charge of the catalytic and thermal cracking divisions there.

Personals

David A. Tanksley, geologist with Continental Oil, has been transferred to Worthington, Ohio, from Billings, Mont. **Clark A. Mueller,** Casper, Wyo., has moved to Billings to succeed Tanksley.

W. G. Denning, acting assistant head of the technical division at Humble's Baytown, Tex., refinery, has been named petroleum-products adviser to the refinery's general manager.

Malcolm P. Stevens has joined the chemical products section at California Research Corp.'s Richmond, Calif., laboratory as research chemist. **Alan A. Goldstein** and **Theodore H. Koundakjian** have joined the Richmond lab as research chemists in petroleum products. **James W. Barnes** has joined the company as research engineer in the process and plant-design group, Richmond.

William K. Hunter, manager of catalyst sales for Universal Oil Products Co., has been named manager of chemical-product development. **Leonard J. Daniels, Jr.,** sales engineer in catalyst sales, will succeed Hunter. **Alfred E. Hoffman,** chemical-products sales engineer, has been named assistant manager, chemical-product sales. **Robert P. Zimmerman,** associate research coordinator in chemical-products research, has been named research coordinator.

Grant A. Brown, general counsel of Amoco Chemicals Corp., has been elected a director. Brown was with Utah Refining Co. before joining Amoco April 1.

Byron C. Bailey has been appointed project engineer for United Carbon Co. in Baytown, Tex. He had been research engineer in the research and development department.

R. T. Burns, Union Oil Co.'s Durango, Colo., district geologist, has been transferred to Los Angeles. **Harold Fothergill,** who recently moved from Los Angeles to Durango, will succeed Burns.

R. A. Winslow, operating superintendent at Humble's Baton Rouge refinery, has been named assistant general manager of the refinery. He replaces **F. D. Dennstedt,** recently named assistant general manager of the manufacturing division in Houston. **T. J. Innes, Jr.,** head of the Baton Rouge mechanical division, will succeed Winslow. **R. W. Ammon,** assistant head of the mechanical division, will move up to replace Innes. In other changes, **J. L. Nanney** has been named assistant head of the mechanical division, succeeding Ammon. **F. G. Turpin** will succeed Nanney as assistant head, chemical - products division. Turpin will be succeeded as assistant head of petroleum-products by **H. C. Leak,** assistant head of the technical division. **R. E. Wood,** associate director of Esso Research Laboratories, will succeed Leak.

William B. Wood, general superintendent of Rio Grande Valley Gas Co., has been elected vice president in charge of transmission and distribution operations. **John T. Ashford,** manager of production, has been elected vice president in charge

WOOD

ASHFORD

of production and gas development. **John Emery,** assistant general superintendent, has been named to succeed Wood as general superintendent. Rio Grande board membership has been increased to seven with election of Ashford and **Paul O. Koester,** Mineral Wells, Tex., as directors. **Robert T. McMinn,** assistant treasurer, has been named assistant treasurer and assistant secretary.

Donald F. Koenecke and **Hugh E. Ramsden** have been named research associates by Esso Research & Engineering Co.

C. O. Garbrecht, vice president of Bay Petroleum Corp., will retire May 1. Garbrecht had been with Texaco, Tidewater, and Ashland Oil & Refining, before joining Bay in 1939 as refinery superintendent in Denver. He was elected a vice president in 1948.

Deaths

Harold H. Wilson, 62, vice president and director of Gulf Coast operations for Jones & Laughlin Supply division, died April 19 in a Houston hospital. Wilson joined Frick-Reid, predecessor of Jones & Laughlin Supply, in 1920 in Tulsa. He became sales manager in Tulsa before being transferred to Houston. He was elected a vice president in 1941 and director of Gulf Coast operations in 1953.

Robert E. Allen, 63, assistant oil umpire for California under the state's old voluntary conservation program, died April 9 at his home in Aurora, W. Va. Allen was a pioneer in Australian exploration in the 1920's and later helped develop Alberta fields. He served on the California oil umpire's staff from 1926-37, was an assistant deputy administrator of the Petroleum Administration for War during World War II, and later served as director of information for API.

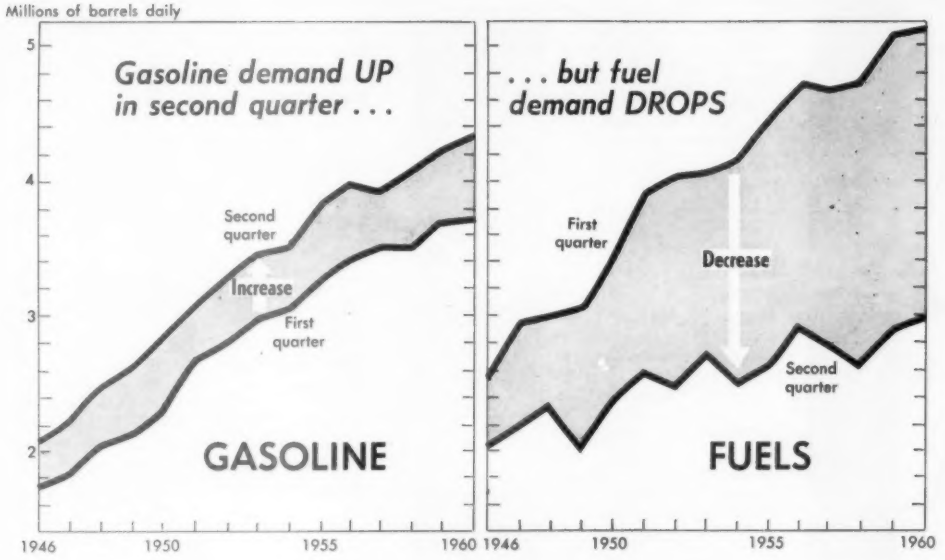
William D. Harris, 62, pipe inspector for Richfield Oil Corp., died April 9 in a Bakersfield, Calif., hospital of a heart ailment.

Ralph G. Harder, 57, head of office staff and management for Asiatic Petroleum Corp., died April 15 in a New York City hospital. Harder had been with Shell Oil Co. and affiliates since 1933.

Robert Sprague Clark, 78, retired store manager for Continental Supply Co., died April 13 at his home in Tulsa of a heart ailment. Clark retired in 1948.

Paul Howard Morris, 26, inspector for Bechtel Corp., was killed April 16 in an auto accident near Hermiston, Ore.

Albert W. Miller, 43, tool pusher with Kerr-McGee Oil Industries, was killed April 8 in an oil field accident near Maracaibo, Venezuela.



SHADED AREAS in the two charts show changes in demand between first and second quarters each year since the end of World War II. Gasoline demand gained only 629,000 bbl. daily between first and second quarters last year. Fuel demand dropped 2,172,000 bbl. daily. Net decrease for the four major products was 1,543,000 bbl. daily.

Drop supply closer to demand this summer

BY JOHN C. CASPER

DOMESTIC DEMAND for petroleum products takes a nose dive in the second quarter each year. These sharp decreases in demand should be met by downward adjustments in supply and definite plans to provide storage space for seasonal increases in product stocks.

Inventory problems are tied to seasonal changes in demand, and postwar growth patterns have added to the supplier's troubles. Summer additions to storage have been climbing rapidly.

There are two reasons for these troublesome storage problems. First, demand for fuels drops off sharply in the second quarter; and the loss is only partially offset by increases in demand for gasoline. Second, refiners have tended to continue crude runs at a high level well into the second quarter or even into the third. July was the peak month for refinery runs last year.

The charts at the top of the page picture changes which result in a big reduction in demand during the second quarter. On the first chart, the bottom line represents gasoline demand in the first quarter. The top line shows second-quarter gasoline demand. The shaded area represents second-quarter increases by years.

At the end of World War II, second-quarter gasoline demand topped demand in the first quarter by 378,000 bbl. daily or 21.8%. By 1960, the gain between first and second quarters was 629,000 bbl. daily, but this gain represented a relative increase of only 16.8%. The spread between quarters has not been gaining as fast as demand.

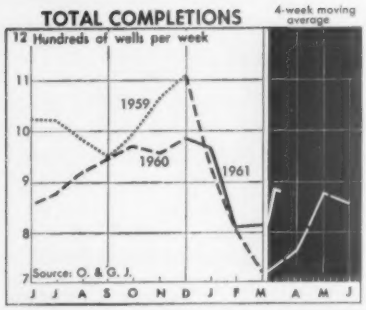
Compare these small gains in gasoline demand with the larger seasonal decreases in demand for fuels. Back in 1946, fuel demand dropped 520,000 bbl. daily or 20.3% between the first and second quarters. Last year the drop was 2,172,000 bbl. daily or 42.1%.

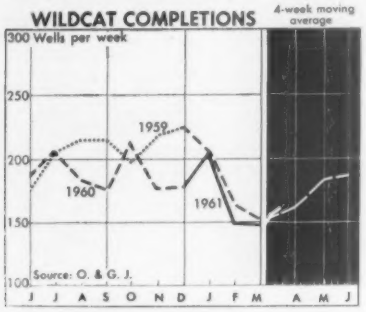
As long as refiners fail to give proper consideration to these seasonal changes in demand, they will be plagued by excessive inventories at the end of the summer season. And, there is a strong chain connecting high inventories, high runs, low prices, and low profits.

A quick look at the highlights . . .

	LATEST WEEK	Change from WEEK AGO		Change from YEAR AGO	
Production	7,263,300	UP	22,975	UP	226,632
Crude stocks	241,135,000	DOWN	2,058,000	DOWN	15,038,000
Completions	800	DOWN	154	UP	78
Refinery runs	7,789,000	DOWN	110,000	DOWN	109,000
Gasoline stocks	223,176,000	DOWN	2,483,000	DOWN	1,621,000
Kerosine stocks	26,494,000	DOWN	125,000	UP	7,641,000
Distillate stocks	86,634,000	DOWN	1,873,000	UP	10,256,000
Residual stocks	42,312,000	DOWN	205,000	UP	3,221,000
Four-product stocks	378,616,000	DOWN	4,686,000	UP	19,497,000
Total imports	1,553,800	DOWN	60,900	DOWN	341,900

Active Rotary Rigs





	4-17-61	4-10-61	4-18-60
Alabama	5	4	3
Alaska	8	8	5
Arkansas	13	12	10
Arizona	0	0	4
California	77	74	91
Land	74	72	86
Offshore	3	2	5
Colorado	18	20	23
Florida	0	0	2
Land	0	0	1
Offshore	0	0	1
Georgia	0	1	0
Illinois	26	26	45
Indiana	9	5	4
Kansas	103	108	129
Kentucky	4	3	8
Louisiana	251	268	303
North	29	28	41
S. Inland waters	101	106	105
S. Land	67	77	99
Offshore	54	57	58
Michigan	15	16	20
Mississippi	49	45	73
Missouri	1	1	1
Montana	21	22	12
Nebraska	25	23	29
New Mexico	102	96	115
New York	0	0	1
North Dakota	14	16	18
Ohio	7	6	4
Oklahoma	185	168	207
Pennsylvania	11	7	11
South Dakota	0	0	1
Texas	601	602	620
S. Inland waters	5	8	10
S. Land	166	171	165
Offshore	3	3	1
North	56	55	44
Panhandle	50	41	52
East	61	55	63
West Central	158	162	185
West	102	107	100
Utah	25	26	30
Washington	2	2	0
West Virginia	4	4	5
Wyoming	62	54	55
Total U. S.	**1,638**	1,617	1,829
Cum. avg. to date	1,569	1,565	1,697
Western Canada	83	99	99
Eastern Canada	0	0	2
Grand total	1,721	1,716	1,930

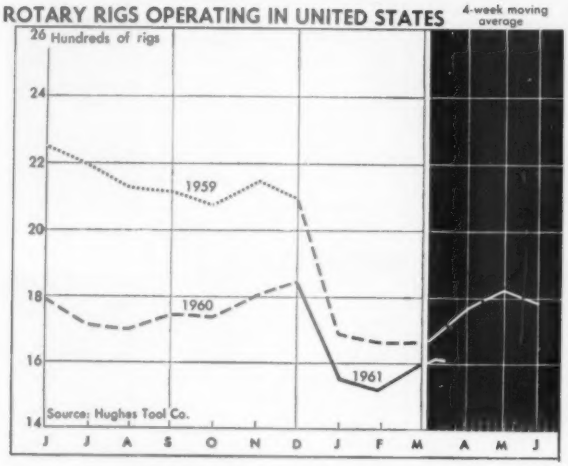
Hughes Tool Co. report.

WEEKLY WELL COMPLETIONS . . . WEEK ENDED APRIL 15, 1961

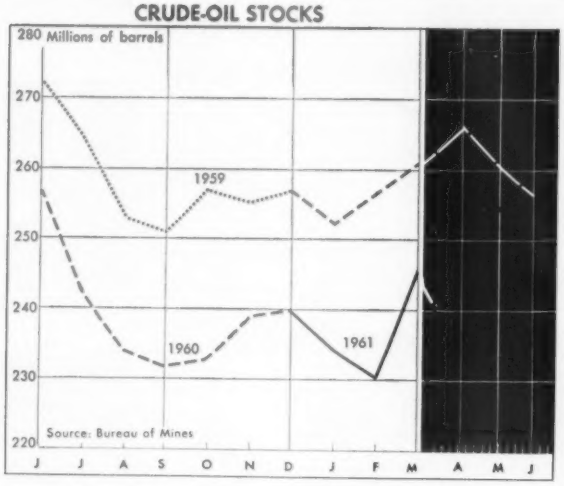
	Total wells							Cum.		Total wildcats					Cum.	
	Total	Crude	Cond.	Gas	Dry	Service	Footage	1961	1960	Total	Crude	Cond.	Gas	Dry	1961	1960
Arkansas	10	2	0	0	7	1	37,710	156	163	2	0	0	0	2	31	41
California	29	17	0	1	8	3	123,482	499	377	2	0	0	0	2	76	82
Colorado	16	7	0	0	9	0	58,151	192	206	4	0	0	0	4	98	95
Illinois	18	12	0	0	6	0	45,019	493	579	4	0	0	0	4	99	151
Indiana	5	2	0	0	3	0	8,042	168	249	2	0	0	0	2	39	106
Kansas	85	50	0	2	30	3	253,000	1,534	901	23	3	0	1	19	300	303
Kentucky	32	5	0	10	16	1	70,440	460	522	4	0	0	0	4	52	63
Louisiana	47	24	0	3	20	0	397,592	1,059	944	5	1	0	0	4	155	143
North	12	5	0	1	6	0	48,213	343	295	2	1	0	0	1	58	58
South	22	11	0	1	10	0	213,917	544	487	3	0	0	0	3	87	75
Offshore	13	8	0	1	4	0	135,462	172	162	0	0	0	0	0	10	10
Michigan	11	2	0	2	7	0	39,307	192	208	4	0	0	0	4	78	67
Mississippi	11	3	0	0	8	0	104,439	154	234	3	1	0	0	2	53	76
Montana	8	3	0	0	5	0	55,745	116	73	4	0	0	0	4	51	35
Nebraska	31	15	0	0	16	0	143,490	247	224	14	2	0	0	12	101	89
New Mexico	34	22	0	5	7	0	156,356	493	540	6	1	0	1	4	90	76
West	16	7	0	4	5	0	66,370	188	182	3	0	0	0	3	24	17
East	18	15	0	1	2	0	89,986	305	358	3	1	0	1	1	66	59
New York	0	0	0	0	0	0	0	183	100	0	0	0	0	0	7	7
North Dakota	5	4	0	0	1	0	32,896	65	87	0	0	0	0	0	16	15
Ohio	17	7	0	1	4	5	48,576	304	326	2	0	0	1	1	13	15
Oklahoma	55	24	2	6	21	2	189,954	1,706	1,085	5	2	0	1	2	176	197
Pennsylvania	44	10	0	15	6	13	127,556	196	185	3	0	0	1	2	10	7
Texas	294	153	16	10	107	8	1,163,314	4,029	4,664	65	4	1	2	58	847	957
District 1	20	15	0	0	5	0	43,771	243	336	3	0	0	0	3	86	120
District 2	14	4	0	2	8	0	97,124	195	199	3	0	0	0	3	39	47
District 3	16	8	1	2	5	0	109,252	304	352	3	0	0	0	3	61	72
District 4	11	1	3	0	5	2	71,485	345	354	3	0	0	0	3	74	102
East	38	28	3	0	7	0	133,429	324	330	1	0	0	0	1	71	69
District 7-B	43	18	1	2	17	5	116,658	564	685	8	0	0	2	6	171	197
West	78	35	3	0	39	1	349,097	1,016	1,254	34	2	0	0	32	230	204
District 9	44	27	4	0	13	0	123,503	657	859	5	2	0	0	3	85	122
District 10	30	17	1	4	8	0	118,995	381	295	5	0	1	0	4	30	24
Utah	8	7	0	0	1	0	48,765	80	74	0	0	0	0	0	32	26
West Virginia	12	1	0	9	0	2	25,177	289	226	0	0	0	0	0	2	2
Wyoming	14	5	0	3	5	1	72,084	297	271	4	0	0	0	4	114	113
Miscellaneous*	14	2	0	3	9	0	36,054	119	59	12	0	0	3	9	86	34
Total U. S.	**800**	377	18	70	296	39	3,237,149	13,031	12,297	**168**	14	1	10	143	2,526	2,700
Total prev. week	954	435	11	111	359	38	4,050,346	.....	.....	175	13	0	12	150	.....	.....
Cum. 1961	13,031	5,987	273	1,285	4,653	833	53,039,707	.....	.....	2,526	209	29	123	2,165	.....	.....
Cum. 1960	12,297	5,711	401	1,043	4,784	358	54,141,731	.....	.....	2,700	232	31	80	2,357	.....	.....
Western Canada	21	7	0	5	9	0	127,866	698	722	5	0	0	2	3	227	225

*Mo., Tenn., Alaska.

ROTARY RIGS OPERATING IN UNITED STATES



CRUDE-OIL STOCKS



CRUDE-OIL STOCKS BY STATES OF ORIGIN*

(Thousands of barrels)

	4-8-61	4-1-61	4-9-60
Pennsylvania	2,081	2,089	2,084
Other Appalachian	1,204	1,199	1,701
Illinois, Indiana, Michigan	9,188	9,750	9,537
Nebraska and North Dakota	3,217	3,292	2,583
Kansas	9,653	9,778	9,692
Oklahoma	15,525	15,335	17,421
Arkansas	1,959	1,859	2,248
Louisiana	19,628	18,851	19,548
North	3,164	3,114	3,383
South	16,464	15,737	16,165
Mississippi, Alabama, Florida	2,220	2,490	2,689
New Mexico	7,386	7,696	7,749
Texas	101,899	102,692	110,117
East Texas	8,696	8,797	8,301
West Texas	46,710	46,388	49,521
Texas Gulf	18,195	18,149	19,992
Other Texas	28,298	29,358	32,303
Wyoming	16,845	17,032	17,358
Other Rocky Mountain	9,950	9,357	9,756
California	25,923	25,926	29,120
Foreign	†14,457	15,847	14,570
Total	**241,135**	243,193	256,173

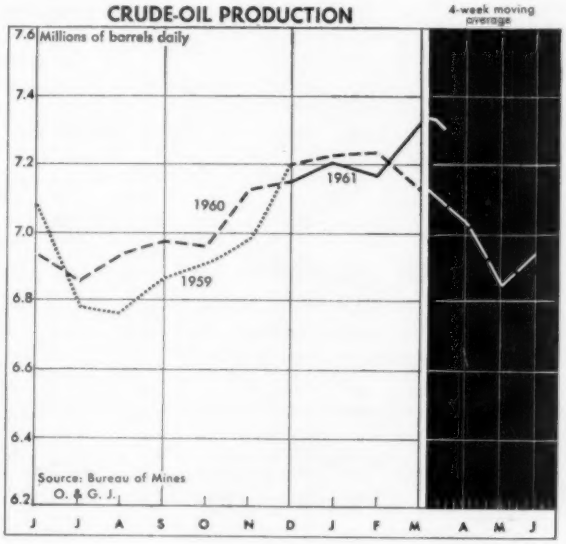
*Bureau of Mines. †Includes 4,625,000 bbl. in California.

DAILY AVERAGE PRODUCTION FOR WEEK

	April 15, 1961			April 8
	Crude oil	Lease condensate	Total	total
Alabama	19,250	.....	19,250	19,325
Alaska	11,000	.....	11,000	11,000
Arkansas	77,430	120	77,550	77,600
California	829,000	.....	829,000	829,500
Colorado	132,000	.....	132,000	132,700
Eastern	40,300	.....	40,300	41,400
Florida	1,100	.....	1,100	1,100
Illinois	206,600	.....	206,600	213,700
Indiana	30,600	.....	30,600	30,900
Kansas	†315,400	.....	†315,400	†305,050
Kentucky	49,900	.....	49,900	49,800
Louisiana	1,002,000	158,250	1,160,250	1,160,300
North	102,000	5,750	107,750	107,800
South	900,000	152,500	1,052,500	1,052,500
Michigan	53,200	.....	53,200	53,000
Mississippi	146,900	4,725	151,625	151,625
Montana	80,300	.....	80,300	80,200
Nebraska	68,800	.....	68,800	68,000
Nevada	400	.....	400	400
New Mexico	304,000	7,400	311,400	311,400
North Dakota	68,000	.....	68,000	69,500
Oklahoma	†553,250	.....	†553,250	†523,400
Texas	2,540,000	94,750	2,634,750	2,634,750
Dist. 1	45,000	2,400	47,400	47,400
Dist. 2	110,000	8,600	118,600	118,600
Dist. 3	312,000	40,000	352,000	352,000
Dist. 4	185,000	14,000	199,000	199,000
Dist. 5	28,000	400	28,400	28,400
Dist. 6	118,000	8,200	126,200	126,200
East Texas field	136,000	.....	136,000	136,000
Dist. 7-B	131,000	400	131,400	131,400
Dist. 7-C	117,000	3,650	120,650	120,650
Dist. 8	1,064,000	11,000	1,075,000	1,075,000
Dist. 9	190,000	3,800	193,800	193,800
Dist. 10	104,000	2,300	106,300	106,300
Utah	82,500	.....	82,500	87,300
Wyoming	385,400	.....	385,400	387,600
Others	‡725	.....	‡725	‡775
Total U. S.	6,998,055	265,245	**7,263,300**	7,240,325
Change from prev. week, up			**22,975**	
Canada	†581,100	.....	†581,100	†459,700
Total U. S. prod., Jan. 1-April 15				760,928,400 bbl.
Same period last year (crude plus cond.)				*§760,972,147 bbl.

*Includes 24,554,170 bbl. condensate. †Week ended previous Monday. ‡South Dakota and Arizona. §Revised.

CRUDE-OIL PRODUCTION



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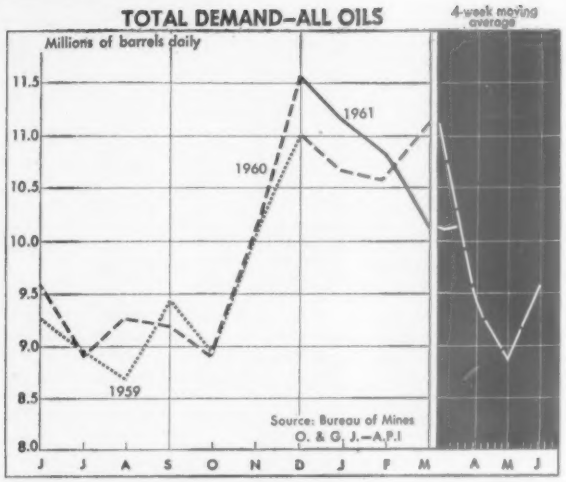

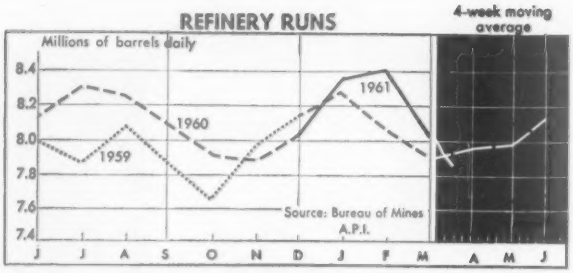

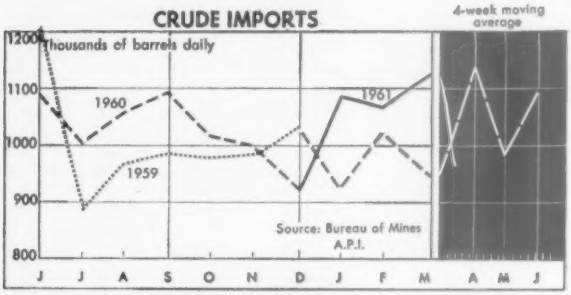

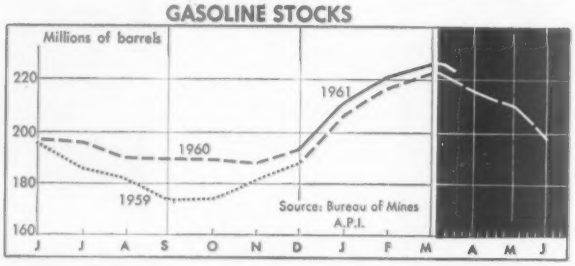

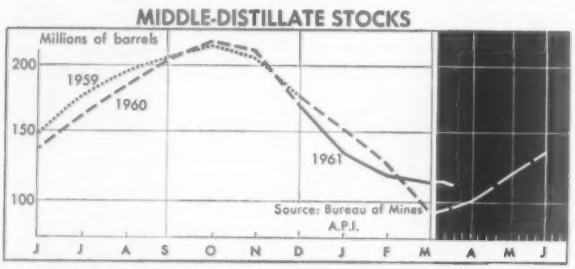

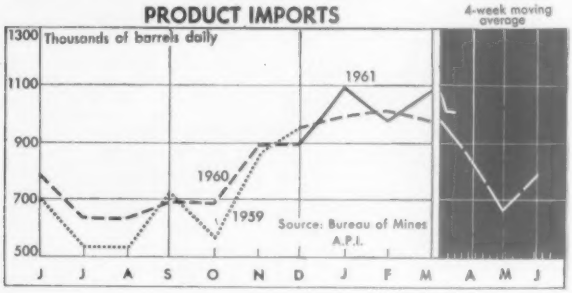

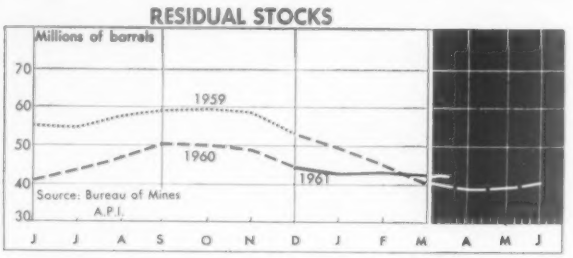

API REFINERY REPORT—APRIL 14, 1961

(Thousands of barrels)

District—	Daily avg. runs	Daily average production—Gaso.*	Kero.	Dist.	Resid.	Stocks‡—Gaso.†	Kero.	Dist.	Resid.	Daily avg. runs	Daily average production—Gaso.*	Kero.	Dist.	Resid.
										Bureau of Mines, April 1960				
East Coast	1,143	484.8	39.4	288.8	149.3	50,676	10,229	25,748	11,487	1,057	510.8	30.1	300.0	146.7
Appalachian:														
Dist. 1	103	37.9	4.1	22.1	4.3	6,005	640	1,721	551	100	41.9	2.9	23.3	12.3
Dist. 2	92	45.6	7.1	14.4	14.6	2,899	427	934	410	90	46.2	4.2	16.6	15.2
Ind., Ill., Ky.	1,308	697.6	64.3	265.3	123.8	42,050	4,343	15,139	5,253	1,480	765.8	77.8	301.0	166.3
Minn., Wis., Dak.	127	68.4	5.7	27.4	16.6	6,765	611	4,042	636	116	56.1	6.4	27.7	14.3
Okla., Kans., Mo.	714	387.4	16.7	163.3	13.7	21,026	1,257	8,885	953	694	350.0	17.4	151.5	14.6
Inland Texas	304	229.7	11.6	49.9	18.6	8,400	598	1,702	2,555	283	212.8	8.2	51.4	120.7
Texas Gulf Coast	1,754	1,010.3	107.6	436.0	86.8	31,873	3,038	7,505	4,323	1,885	964.0	93.9	439.5	141.2
La. Gulf Coast	642	312.7	65.9	117.4	51.3	11,187	2,854	4,311	1,442	665	366.6	46.9	154.7	48.8
N. La. and Ark.	113	71.3	3.4	25.6	5.4	5,651	596	2,008	144	106	65.2	5.5	21.6	4.7
Rocky Mountain:														
New Mexico	25	11.7	0.6	5.4	2.9	778	44	163	91	23	11.4	0.1	4.3	2.5
Other Rocky Mt.	261	118.6	1.6	63.3	27.7	7,934	355	2,349	1,006	265	114.4	1.5	60.7	24.1
West Coast	1,203	523.1	23.7	162.1	282.3	27,932	1,502	12,127	13,461	1,196	541.3	29.9	191.0	268.9
Apr. 14, 1961	7,789	3,999.1	351.7	1,641.0	797.3	223,176	26,494	86,634	42,312	7,960	4,046.5	324.8	1,743.3	880.3
Apr. 7, 1961	7,899	3,997.1	410.3	1,612.0	861.7	225,659	26,619	88,507	42,517	.....	.....	.....	.....	.....
Apr. 15, 1960	7,898	4,067.4	342.1	1,749.9	965.9	224,797	18,853	76,378	39,091	.....	.....	.....	.....	.....

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipelines.

CRUDE-OIL PRICES

GRAVITY SCHEDULE

	Signal Hill, Calif.	Oklahoma	West Tex. (sour)	West Tex. (Inter.)	No.* Texas	Texas Refugio Light	Bayou Sale (La.)	Denver Jules-burg	Wyo. (sour)
14-14.9	$1.86	....	....	....	....	....	....	....	....
15-15.9	1.93	....	....	....	....	....	....	....	$1.81
16-16.9	2.00	....	....	....	....	....	....	....	1.86
17-17.9	2.06	....	....	....	....	....	....	....	1.91
18-18.9	2.13	....	....	....	....	....	....	....	1.96
19-19.9	2.20	....	(†)	....	....	....	....	....	2.01
20-20.9	2.27	$2.49	$2.35	$2.61	$2.29	$2.95	$2.90	$2.58	2.06
21-21.9	2.33	2.52	2.38	2.63	2.33	2.97	2.92	2.60	2.11
22-22.9	2.40	2.55	2.41	2.65	2.37	2.99	2.94	2.62	2.16
23-23.9	2.46	2.58	2.44	2.67	2.41	3.01	2.96	2.64	2.21
24-24.9	2.53	2.61	2.47	2.69	2.45	3.03	2.98	2.66	2.26
25-25.9	2.60	2.64	2.50	2.71	2.49	3.05	3.00	2.68	2.31
26-26.9	2.67	2.67	2.53	2.73	2.53	3.07	3.02	2.70	2.36
27-27.9	2.74	2.70	2.56	2.75	2.57	3.09	3.04	2.72	2.49
28-28.9	2.81	2.73	2.59	2.77	2.61	3.11	3.06	2.74	2.54
29-29.9	2.87	2.76	2.62	2.79	2.65	3.13	3.08	2.76	2.59
30-30.9	2.93	2.79	2.65	2.81	2.69	3.15	3.10	2.78	2.63
31-31.9	3.00	2.82	2.68	2.83	2.73	3.17	3.12	2.80	2.67
32-32.9	3.06	2.85	2.71	2.85	2.77	3.19	3.14	2.82	2.71
33-33.9	3.12	2.88	2.74	2.87	2.81	3.21	3.16	2.84	2.75
34-34.9	3.17	2.91	2.77	2.89	2.85	3.23	3.18	2.86	2.79
35-35.9	3.22	2.94	2.80	2.91	2.89	3.25	3.20	2.88	2.83
36-36.9	3.27	2.97	2.83	2.93	2.93	3.27	3.22	2.90	2.87
37-37.9	3.31	2.99	2.86	2.95	2.95	3.29	3.24	2.92	2.89
38-38.9	....	3.01	2.89	2.97	2.97	3.31	3.26	2.94	2.91
39-39.9	....	3.03	2.92	2.99	2.99	3.33	3.28	2.96	2.93
40-44.9	....	3.05	2.95	3.01	3.01	3.35	3.30	2.98	2.95

*Cooke, Grayson, Montague. †Two buyers announced increase.

FLAT PRICES

Louisiana:
- Sweet Lake $3.00

Texas:
- East Texas 3.05-3.25
- Conroe 3.23-3.53
- Van 3.08

Pennsylvania Grade:
- Bradford $4.75-4.80
- Middle District 4.52
- Southwest Pennsylvania 4.25
- West Virginia 4.17
- Buckeye Grade 4.08

Illinois Basin **3.00-3.05**

FOREIGN

Middle East, Persian Gulf: (cargoes f.o.b. lifting port)
- Arabian, 34.0°-34.9°, Ras Tanura $1.80
- Iranian, 34.0°-34.9°, Bandar Mashur 1.78
- Iranian, 34.0°-34.9°, Abadan 1.73
- Iraq, 35.0°-35.9°, Fao 1.72
- Kuwait, 31.0°-31.9°, Mina-al-Ahmadi 1.59
- Qatar, 41.0°-41.9°, Umm Said 1.95

Middle East, E. Mediterranean:
- Arabian, 34.0°-34.9°, Sidon $2.17
- Iraq, Mosul-Kirkuk, 35.0°-35.9°, Tripoli 2.19

Far East (cargoes, f.o.b. Lutong, Sarawak):
- Seria Light, 36° 2.42

Canada:
- Leduc-Woodbend $2.53
- Redwater (Alta.) 2.42
- Weyburn (light) 2.06
- Midale C 1.70

Venezuela:
- Cumbarebo, 47°-47.9°, Tucupido 3.34
- San Joaquin, 40°-40.9°, Puerto La Cruz 3.08
- Oficina, 35°-35.9°, Puerto La Cruz 2.80
- Tia Juana medium, 26°-26.9°, Amuay* 2.30
- Quiriquire, 16.0°-16.4°, Caripito 2.10
- Lagunillas heavy, flat, Las Piedras* 2.10
- Bachaquero, flat, 15°-16°, Las Piedras* 1.88

Prices for all crudes of 24° or lighter vary 2 cents per degree change, up or down. All crudes heavier than 24° vary 2.5 cents per half-degree gravity change.

*Also available at La Salina at 3 cents per barrel less.

TANKER RATES (Long Ton)

(Latest reported spot fixtures)

- ★ Gulf-NY, dirty (ATRS—35%) $1.85
- ★ Carib.-NY, dirty (ATRS—62.5%) 1.03
- ★ Carib.-UK, dirty (Scale—60%) (13s. 0d.) .. 1.82
- PG-UK, dirty (Scale—62.5%) (24s. 2d.). 3.38
- PG-Japan, dirty (USMC—71%) 2.96

★ Denotes change from previous week.

REFINED PRODUCTS

Following quotations are realistic spot prices for refined products moving interstate on Wednesday each week. They may differ from refiners' posted prices and should not be considered as postings.

Light-product prices are in cents per gallon. Residual and crude prices are dollars per barrel. Crude prices are at the well unless otherwise listed.

GASOLINE*

Mid-Continent (Group 3):
- Regular (91 octane).. 12.25-12.50
- Premium (99 octane). 15.00-15.25
- Natural gasoline (26-70) 4.5
- Breckenridge 4.0

Gulf Coast (cargoes for coastwise or export movements):
- Regular (90 octane) .. 10.50-11.00
- Regular (92 octane) .. 10.75-11.25
- Premium (98 octane). 11.75-12.25

California (rack) Los Angeles:
- Regular (90 octane) 11.00
- Premium (94 octane) 12.00
- Premium (100 octane) 13.50

Caribbean area (cargoes):
- Regular (87 octane) 9.50
- Premium (97 octane) 11.625

*Quotations are for octanes shown. Prices usually vary with octane ratings within the regular, premium, and aviation grades.

KEROSINE AND DISTILLATE

Mid-Continent (Group 3):
- Kerosine 42-44 ....10.375-10.625
- Diesel oil (58 d.i. and above) 10.00-10.25
- Distillate No. 1 .... 10.00-10.25
- Distillate No. 2 .... 9.00-9.25

Gulf Coast (cargoes):
- Kerosine 41-43 .... 9.625-9.875
- Distillate No. 2 .... 9.00-9.25

New York Harbor (barges):
- Kerosine 42-43 ..... 11.40
- Distillate No. 2 ..... 10.40
- Diesel fuel, 48-52 d.i. 10.55

Caribbean area (cargoes):
- Distillate No. 2 ..... 8.625

RESIDUAL FUEL (Bbl.)

Mid-Continent (Group 3):
- Residual fuel (max. 1% S).. $1.90

Gulf Coast (cargoes):
- Bunker C fuel 2.20

New York Harbor (barges):
- Bunker C fuel 2.52

Caribbean (cargoes):
- Bunker C 2.00

California (rack):
- Bunker C fuel, Los Angeles 2.25

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for the oil and gas industry

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UNDISPLAYED CLASSIFIED 30c a word per issue. 10% discount three or more consecutive issues. $5.00 minimum charge. Blind Box in our care nine words.

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WESTERN STATES: (California, Washington, Oregon, Idaho, Nevada, Utah, and Arizona). Write: Classified Departments, Inc., The Oil and Gas Journal, 4041 Marlton Ave., Los Angeles 8, Calif. Phone AXminister 2-0287.

FOR SALE EQUIPMENT

YOU ARE LOSING MONEY . . .
if you have idle or extra oil field equipment not in productive use. You can sell this equipment through the Classified Pages of The Oil and Gas Journal—Why not give us a try next issue?

2-300 bbl. welded tanks with fitting and walk. High and low pressure separators, heater, metering separator. All like new. Lundquist Pipe and Supply Company, Tulsa. LUther 3-9563.

FRANKS SR. SERVICING UNIT
C/W bed, tool boxes, front and rear pole mountings, large PTO box. $1,750.00. John Cassidy, Jr., 1701 First National Bldg., Tulsa, Oklahoma, LU 5-8368.

1500 FAILING long mast and kelly, gasoline or propane powered with or without Ingersoll-Rand percussion tool. Fred E. Butler, Box 481, Pueblo, Colorado.

WALKER-NEER C-34, Automatic cathead, tools, doghouse, lighplant, float, GMC truck to move equipment. Phone S. H. Lindley, HI 9-2884, Breckenridge, Texas.

1—COMPLETE UNIT Rig for sale U-34 Drawworks Powered by 2 WAKBU Waukesha engines. Sub-structure. 96' Lee C. Moore Derrick. Drill pipe 4½". Drill Collars. Located in Utah. Contact M. Rumsey 330 South Socora, Wichita, Kansas. Parkview 21024. Complete inventory on request.

WELL DRILLS, Core Drills. New and used equipment. Many sizes at bargain prices. Complete supplies. Nation wide distribution. If you want to buy or sell, contact: Pressey & Son, Pueblo, Colorado.

U-15 complete, 131' Mast, 7¾ x 16 Gardner-Denver Pump, 7 Substructure, 3 NK Waukesha Motors, Grade E Drill Pipe, B.O.P. Steel Mud Pits.

1—7¼ x 10 Gardner-Denver Pump

U-15 with 2 NK Motors, 7¼ x 14 Oilwell Pump, no drill pipe or drill collars. Bargain, Lease purchase arrangement available, call General Drilling Company CE 2-6318, Oklahoma City.

USED STORAGE TANKS
For immediate shipment, located near Shreveport, La. All A-1 condition. Will sell standing or knocked-down.
3—36' x 35'4" Welded tanks, 6400 bbl. cap.
37—24' x 20' vertical type—riveted, 1768 bbl. cap. Bottom 3/16", First ring ½", 2nd ring 3/16", 3rd ring 5/16", top 3/8". Call or wire:
LOUISIANA IRON & SUPPLY CO.
Shreveport, La., Tel. 424-8135.

LOCATED HOUSTON, TEXAS
(from Amoco Refinery Co., Destrehan, La.)
HEAT EXCHANGERS
50 to 4,000 sq. ft.
VESSELS—TOWERS
12" to 8' dia.
PETROCHEM FURNACES
½MM, 2½MM, 5MM BTU
PUMPS
50 to 7,000 GPM
—WIRE—PHONE—WRITE—
BRILL EQUIPMENT COMPANY
4101 SAN JACINTO ST., HOUSTON 4, TEXAS
35-65 JABEZ STREET, NEWARK 5, N. J.

FOR SALE EQUIPMENT

2500 FAILING 58' mast, diesel powered, 5 x 8 pump. Sell or rent. Box M-362, The Oil and Gas Journal, Tulsa, Oklahoma.

75 H.P., Reda Pump, 78 stage, complete with 100 H.P. switch box, auto transformer, 2100 ft. armored size I cable. McAdams Pipe & Supply Co., P. O. Box 658, Bristow, Oklahoma—Phone 1711.

DOUBLE DRUM spudder on IHC Truck. Cooper E563-42-36. Excellent Condition. Box 736, Great Bend, Kansas—GL 3-8817.

CLARK MA-4 Gas Compressor, 150 HP, skid-mounted with radiator and accessories; 2 I.R. XVG6 Gas Compressors; 225 HP Worthington LT6 Compressor; Pumps; Exchangers; Vessels. Brill Equipment Company, 4101 San Jacinto St., Houston 4, Texas.

HIGHLIGHTS

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12,000 BSD Naphtha
5,000 BSD Heating Oil

POWERFORMER
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Will Be Sold As Units or Piecemeal

PETRO-CHEM ISO-FLOW FURNACES with STAINLESS CONE AND TIP

30.7 MM BTU/hr.	CHROME Tubes
19.3 MM BTU/hr.	CHROME Tubes
17 MM BTU/hr.	CHROME Tubes
9.7 MM BTU/hr.	CHROME Tubes
9 MM BTU/hr.	Carbon Tubes
7.5 MM BTU/hr.	CHROME Tubes (2)
5 MM BTU/hr.	Carbon Tubes
2.5 MM BTU/hr.	Carbon Tubes
2 MM BTU/hr.	Carbon Tubes

CENTRIFUGAL BLOWER NEW 1954
7,500 CFM @ 14.4 PSIG SUCTION 42.5 PSIG
Disch. Multi-Stage 8,025 RPM driven by 1,250 HP Synchronous Motor 3/60/2,300/1,200 RPM, 5 KW Direct Conn. Exciter, Falk Speed Increaser 6.70:1 Ratio, Precooler, Intercooler, and Aftercooler.

Send Us Your Requirements

HEAT & POWER CO. INC.
60 East 42nd St., New York 17, N.Y.
310 Thompson Bldg., Tulsa 3, Okla.
Box 5203, Baltimore 24, Maryland

EQUIPMENT WANTED

NEED IMMEDIATEDLY—Gas Compressor. Capacity: 500-700MCF/Day. Inlet Press: 100 Psig. Discharge Press: 900 Psig. Wire—Write Price to: G. A. Smitherman, Bank of the Southwest Bldg., Houston, Texas.

WANTED

Used Reda Pump. Must be capable of lifting 12,000 barrels of salt water per day from 1,000 feet and run in 8⅝" casing. State HP of motor, size of pump, voltage required, condition and asking price in first response. Also 3 used 1,000 bbl. bolted ungalvanized tanks, one to be cone bottom. Tank to be within 200 mile radius of Tulsa.

HOME-STAKE PRODUCTION COMPANY
Attention: Harold Lawver, 2301 Philtower Bldg.
Tulsa, Oklahoma Phone LU 4-5281

FINANCING

EXPERIENCED PRODUCER, want associates to drill 500 ft. Bartlesville sand, offset to nice producer. Montogomery County, Kansas. Will furnish references. Box M-320, The Oil and Gas Journal, Tulsa, Oklahoma.

HELP WANTED

AGGRESSIVE AMBITIOUS Petroleum Engineering graduate, experienced in conditioning wells and taking samples of reservoir fluid. Must qualify as a technical expert with management potential in addition to superior performance in the field. Box M-365, The Oil and Gas Journal, Tulsa, Oklahoma.

TRANSLATORS—ENGINEERS WANTED. Proven ability to translate technical material into fluent English essential. Attractive full time or free-lance arrangement. All languages of interest, particularly Russian. Send resume to: A•T•S, Inc., Drawer 271, East Orange, N. J.

NATURAL GAS Engineer with engineering degree plus 3 to 5 years experince in plant design or operation for work in the Gulf Coast Area. Amerada Petroleum Corp., Gas Department, P. O. Box 2040, Tulsa, Oklahoma.

MATERIAL AND Production Clerk to age 30 with 3 to 5 years experience, preferably with major company, to be located in Poteau, Oklahoma. Man should be alert, aggressive and generally familiar with oil and gas drilling and production operations. Salary—commensurate with ability. Write Midwest Oil Corporation, 1200 Continental National Bank Building, Fort Worth, Texas, enclosing college transcript, photo and qualifications. All replies will be treated with strictest confidence.

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RAISE VENTURE CAPITAL FOR OIL GAS OPERATIONS

We want to hire a man who is already successful in convincing individuals in NYC area in invest venture capital in drilling programs. He will manage our New York office and use his experience, contacts, and knowhow to raise exploration money for us—a Houston-based, successful firm of independent operators. He will get excellent remuneration, interest in wells, and unlimited opportunity to build a future. NYC interviews will be scheduled with applicants who send biographical data, a recent photo, and indication of the risk capital they are now raising. All replies will be kept completely confidential. Box M-356, The Oil and Gas Journal, Tulsa, Oklahoma.

HELP WANTED

OIL JOB DIRECTORY, foreign and domestic, showing where to apply for jobs. $5.00 cash OIML Co., Box 2603, Tulsa, Oklahoma.

GRADUATE ENGINEER with 5—10 years field construction experience of gas transmission lines and who is also familar with office work. Prefer applicant not over 40. Salary open. Send resume to Box M-364, The Oil and Gas Journal, Tulsa, Oklahoma.

ASST. REFINERY SUPERINTENDENT
Growing Refiner in Chicago Area has outstanding opportunity for graduate chemical engineer with 4 to 5 years of oil refinery experience. Send Resume to: Box M-351, The Oil and Gas Journal, Tulsa, Oklahoma.

SITUATIONS WANTED

MECHANICAL MAINTENANCE Supervisor available. Age 40. 20 years experience. Engines, Pumps, and all related pump station and refinery equipment. U. S. and foreign. 14 years last position. Fluent Spanish. Box M-366, The Oil and Gas Journal, Tulsa, Oklahoma.

EXPLORATION-PRODUCTION man with degree and water flood experience desires to relocate. Box M-368, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST, 39, M.S. Ten years experience, exploration, drilling, completion, promotion. Major and independent. Prefer interest deal. Box M-363, The Oil and Gas Journal, Tulsa, Oklahoma.

EXECUTIVE MANAGEMENT
Age 40—10 years actual field and executive experience in all phases of landlease, drilling and production (including secondary recovery methods & studies), exploration prospect & producing property appraisals, and financial and corporate management. Travel-Contact Position Preferred. Box M-360, The Oil and Gas Journal, Tulsa, Oklahoma.

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LEGAL

U. S. DEPARTMENT OF THE INTERIOR, Bureau of Land Management, Land Office, Cheyenne, Wyoming. Notice is hereby given that 17 parcels of land totaling 1,869.41 acres within the known geologic structures of a number of fields in Fremont, Natrona, Park, Sweetwater and Weston Counties, Wyoming, are offered for competitive oil and gas leasing through sealed bids to the qualified bidder of the highest cash amount per acre at 2:00 P.M., MST, June 7, 1961, when bids will be opened. Full details of the offering, and how and where to submit bids, may be obtained from the Land Office, Cheyenne, Wyoming. Arvin H. Olswold, Chief, Minerals Section.

LEGAL

U. S. DEPARTMENT OF THE INTERIOR, Bureau of Land Management, Santa Fe, New Mexico. Notice is hereby given that approximately 4,842.13 acres of land in thirty-one parcels within the known geologic structure of certain fields in Eddy, Lea, Rio Arriba, and San Juan Counties, New Mexico, will be offered for competitive oil and gas leasing through sealed bids to the qualified bidder of the highest cash amount per acre at 2:15 p.m., MST, May 16, 1961, when bids will be opened. Details of the lease offering, how and where to submit bids, may be obtained from the Bureau's Land Office at Santa Fe, New Mexico. Douglas E. Henriques, Manager.

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(Continued from page 216)

LOUISIANA OFFSHORE

Main Pass Area:

Gulf Oil Corp. 1 Haydman et al. Unit 1, 26-16s-17e. IP 288 BOPD, 10/64-in., 31.8°, TP 1,150 psi., GOR 504 cu. ft. per bbl., perf. 7,972-78 ft. TD 10,200 ft. New pay in Main Pass Block 12 field.

NORTH LOUISIANA

Catahoula Parish:

McGoldrick & Watson Drilling Co. 1 Pinhook, C NW NW 33-6n-7e, 2 miles southwest of Lismore Landing field. IP 109 BOPD, 10/64-in., 48°, TP 340 psi., GOR 320 cu. ft. per bbl., perf. 5,463½-64½ ft. Wilcox-Tew Lake sand. TD 6,009 ft. Discovery well of Pinhook field.

SOUTH LOUISIANA

Plaquemines Parish:

Benin Oil Co. and Argo Oil Corp. 1 Delacroix Corp., 8-16s-16e. IP 1,250 M.c.f.d., 8/64-in., TP 3,500 psi., perf. 9,068-72 ft. TD 10,800 ft. New-field discovery.

St. Mary Parish:

Mississippi River Fuel Oil Corp. 1 State Lease 3,503 in Atchafalaya Bay. IP 4,175 M.c.f.d., 14.16 BC per M.M.c.f., 14/64-in., 53.5°, TP 3,500 psi., perf. 10,714-20 ft. TD 12,450 ft. New-field discovery.

MISSISSIPPI

Jefferson County:

Argo Oil Corp. and Chartor Oil Co., 14-10n-2w. IP 182.5 BOPD, ⅛-in., 42.3°, GOR 2,150 cu. ft. per bbl., TP 2,275 psi., perf. 9,200-15 ft., Tuscaloosa stringer sand. TD 9,400 ft. Discovery well of Gilliam Chute field.

NEBRASKA

Hitchcock County:

National Associated Petroleum Co. 1 Steinke, C NW NW 28-1n-33w. IPP 50 BOPD, Lansing-Kansas City 3,936-4,066 ft. TD 4,555 ft. Lansing-Kansas City discovery, new field.

NEW MEXICO

Eddy County:

George R. Brown 1 Humble 10 miles southwest of Dayton in 17-20s-25e. IPCAOF 3,500 M.c.f.d., Morrow 9,346-9,434 ft. TD 9,600 ft. New gas discovery.

Nash, Windfohr, & Brown 22-B Jackson, 28 miles east of Artesia in 24-17s-30e. IPF 85 BOPD, 10/64-in. choke, 44.4°, GOR 1,374:1, TP 620 psi., packer, Abo 6,955-90 ft. TD 7,050 ft. New Abo reef trend discovery.

OKLAHOMA

Garfield County:

Alex McCoy Associates Inc. 1 Troska, 4½ miles northwest of Northwest Bison field in C SE SW 28-21n-7w. IPF 1,790 M.c.f.d., plus 4 BCPD, 20/64-in. choke, Oswego and Meramec 6,267-75 and open hole at 6,895-7,001 ft. FTP 1,075 psi., GOR 44,000:1, 60°. TD 7,001 ft. New oil and gas-condensate discovery, dual completion.

Kingfisher County:

Champlin Oil & Refining Co. 1 Violet Sturgeon, 10 miles southwest of Hennessey in SW SW 4-18n-5w. IPF 10 BOPD, ¾-in. choke, open hole Meramec 6,327-6,420 ft. TD 6,240 ft. New oil discovery.

Lincoln County:

Wm. H. Pine 1 DeWitt, 3½ miles northwest of Payson pool in C SW NE 22-13n-4e. IPF 6 BO/6 hours, open tubing, SITP 370 psi., 38°, Skinner 4,173-77 ft. TD 4,290 ft. New oil discovery.

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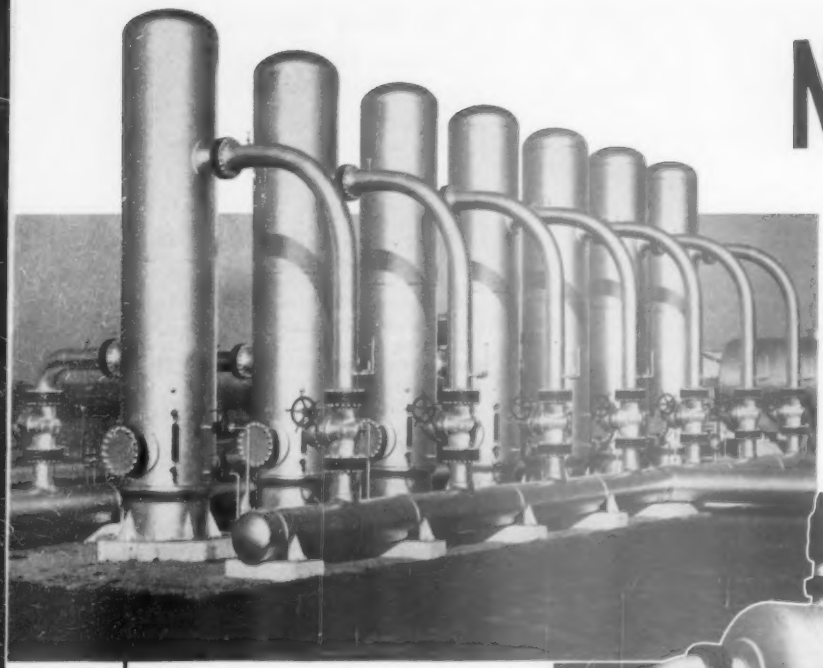

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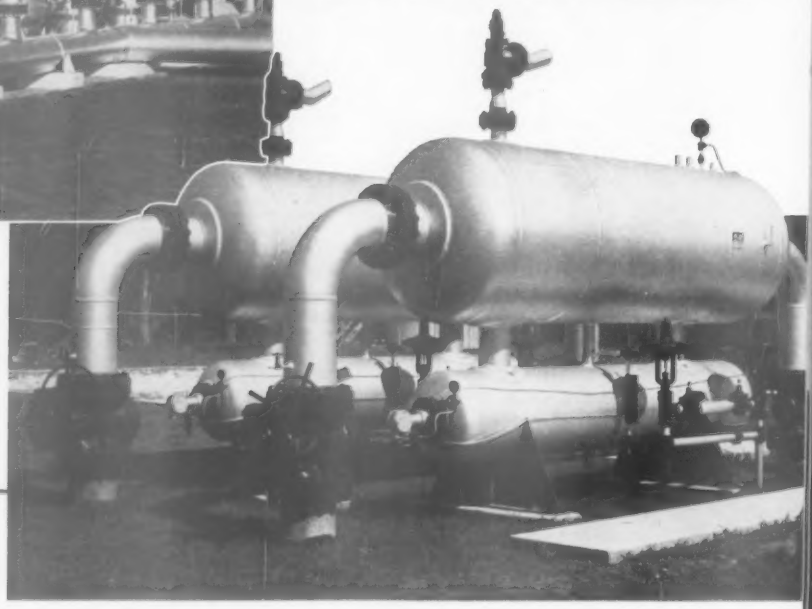

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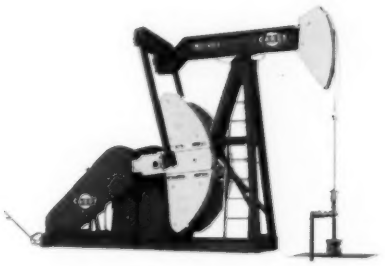

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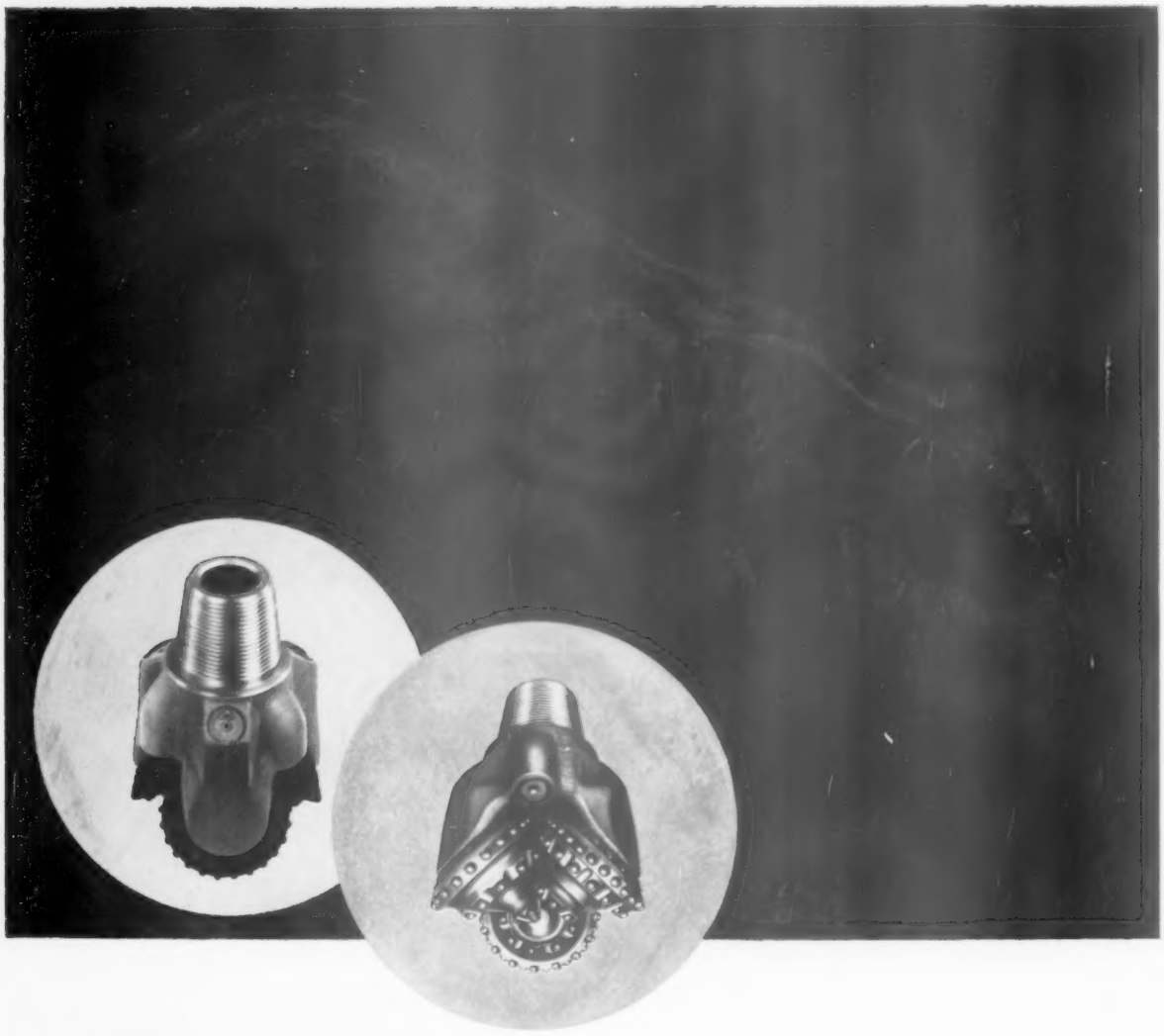

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